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Track Scales

THE Bridge and Building Association committee on Track Scales in its investigations, found conditions similar to those which formerly obtained in railway turntables. In the former case, the design of turntables was generally left to the company furnishing the structure.

Competition under these conditions naturally leads to skimping in the preparation of plans, and frequently to skimping in different members of the design. A similar condition may be said to now exist in the building trades, among the exponents of flat slab design. The man who is planning to build a structure is usually a non-technical man, and this fact may be some justification for the acceptance of those plans which will make the cheapest structure. This leads to skimpy designs with high unit stresses, which work alright as long as nothing extraordinary or unforseen occurs. But a temporary overload combined with defective material may result disastrously.

Competitive conditions lead to extensive use of standard details and standard patterns. A change in sizes of members requires first, extra cost for computations and drawings, and second, additional cost for new patterns.

So-called competitive prices are quite likely to be far from being really competitive. All engineers will agree that the way to obtain real competition is to obtain bids on the same basis, or in other words on identical designs.

The acceptance of commercial designs, according to the information given in the Scale Report, was a proceeding of very doubtful economy. It appears likely that the increase in revenue obtained by good design would have paid, many times over, the expense of a competent scale department.

The outstanding lesson which should be drawn from this report is that the awarding of business on price alone is likely to be uneconomical, unless bids are made on identical equipment. And if plans are not prepared, contracts should not be awarded until an investigation or tests, or both are made, and the actual capacity of the designs is determined, as far as may be possible.

Railway Traffic and Sea Traffic

CONSIDERABLE attention has been drawn to the operation of ocean boats on account of the recent unusually large number of sea accidents. The proper handling of ocean traffic is a difficult matter, due to the many interests involved—it is an international affair and there is likely to be introduced national precedents and prejudices.

On leaving a port of entry, it is now necessary for the man in charge of the boat to take out clearance papers in duplicate. These must contain, among other information, the name of the boat and home port, its tonnage, sailing port, destination, sometimes the stopping points, general statement describing cargo, and specific statement of explosives or firearms carried.

In the Atlantic and Pacific oceans, traffic in different directions is handled in "lanes" about 20 miles wide, all boats in one direction attempting to keep in one lane, while boats in the opposite direction are supposed to keep within an adjacent lane. This system of lanes was developed by General Maury, an American.

It seems as if these precautions are insufficient for the present and constantly increasing number of boats and sea traffic, and it seems possible that new routes will have to be picked out for a

portion of the sea vessels. Of course, the increasing number of vessels, which seems in a measure responsible for accidents, is a good thing in case of accidents—relief and aid are likely to be much nearer and wireless makes communication easy.

The greatest trouble seems to be caused by smaller vessels, without wireless equipment, commercial vessels which possibly do not have as high a class of men in charge as the larger liners. It would seem that these smaller vessels should have definite information as to the probable meeting points with other scheduled boats, so that special care and precautions could be taken when in the vicinity of other ships.

A regular despatching system is now in use on the Suez Canal, meeting points being specified for each boat, and the operation is quite similar to operation of trains on a single track line. Such a system, if it could be adopted, would render sea traffic safer.

Loyalty

THE old time railway official was very autocratic and arbitrary in his dealings with employes, and the fact that this policy antagonized his subordinates had no effect on him. His reign was absolute—and he reigned through fear.

Such a condition could not continue long after railway positions began to be filled by men on account of their abilities, and not because of friendship, relationship or favoritism. The scarcity of laborers and high class workmen for other necessary work is another influence which has and is gradually eliminating the arbitrary methods of former years.

The up to date official realizes that there are hundreds of ways in which employes can cause trouble by neglect, by ignoring conditions which do not pertain to their own particular work, by excusing negligence in others, etc.

To get conscientious work out of men, of whatever nationality, requires that the laborer be loyal to his foreman, and that the forman be loyal to his superior. These facts explain why the popular men are now attaining to the highest positions in railway service.

These men obtain the loyalty of their subordinates not through conscious effort, but through considerate treatment of employes in all their manifold duties—by giving each employe all possible chances to advance in knowledge and position—and then by recommending his exceptionally bright and conscientious employes for promotion when higher positions are to be filled.

Many railway positions require more of executive than of practical ability, though in every case executive ability will be crippled without the grounding of practical experience. But with successive promotions, the broadening of duties gradually displaces the former detailed duties of practical work, till finally the engineer, if promoted to the operating department, has little of the kind of work which he formerly was concerned with. The knowledge which he has accumulated in engineering subjects is a valuable asset to him never the less.

Recent railway conditions tend to constantly force men of ability into the responsible railway positions—for it becomes constantly more necessary to run railways more efficiently to offset the encroaching demands of higher wages, better equipment, and better terminals. The official who so conducts himself as to win and hold the loyalty of his subordinates will be most likely to show the greatest results, and thus deserve continual advance.

State or Federal Control of Railways.

AT Shreveport, La., a body of shippers some time ago decided that they were being discriminated against in that rates to Texas centers were higher as charged them than were the rates from Texas cities to these same centers for the same or greater distances. Upon protesting to railway officers it was learned that the lower rates between the points in Texas were probably confiscatory, but nevertheless required by the Texas commission. The result was real discrimination in favor of Texas shippers against those of neighboring states. No doubt the discrimination was intentional on the part of Texas state officials.

When brought to the attention of the Interstate Commerce Commission it was ordered that the railways must cease charging more for the same service inter-state than intra-state. This decision has recently been upheld by the Supreme Court. In the opinion Justice Highes says: "Wherever inter-state and intra-state transactions are so related that the government of one involves control of the other, it is Congress and not the State that is entitled to prescribe the final and dominant rule."

The wisest statesmen of the country hesitate at the thought of Government ownership of railways, but they see only one alternative and that is viewed with grave doubt. This alternative is the only method short of Government ownership which is yet to be given thorough trial: the exclusive control by the Federal Government over the railways in all their transactions, inter-state or intra-State. Considering this latest decision of the Supreme Court, it would seem that this method would soon be given trial.

It is to be hoped that this trial will be a fair and thorough one, and to gain this end it will be necessary that there be the fullest coöperation between Government and railways for the public welfare and that the commission pay the most impartial regard to railways, shippers, passengers and employes. If this coöperation obtains there should be prosperity for the railways, but if it does not the "skids will be greased" and the railways launched into the waters of Government ownership—a veritable sea of doubt.

THE "LEVITATED" RAILWAY SCHEME.

Few engineering proposals have had such a curious experience as that which has befallen M. Bachelet's "levitated" railway scheme, a prospectus for the raising of £90,000 in connection with which was placed before the public recently. In the first place, the prospectus contains no report from an independent engineer as to the technical merits of the patent, nor any expert opinion on the value of the patents themselves. In addition, whilst the scheme has received the most lavish, and indeed extravagant, notice from the daily papers, the general comments of the technical press have been all the other way. At the same time, it is noticeable that one influential paper which helped to give the scheme much publicity of a sensational character, subsequently apparently took some notice of what the technical press was saying, and warned its readers against subscribing. All that the inventor has done so far is to construct a model of a railway in which magnets placed along the line produce eddy currents in aluminum plates fixed underneath the car and lift it off the ground. The car is then drawn along by the magnetic attraction of solenoids fitted with make-and-break contacts. The principle of this has been known for many years as an interesting and amusing scientific fact, but there seems to be general incredulity at the possibility of applying it on a commercial scale sufficient to justify a large subscription of capital by the public. It may be that M. Bachelet is quite right in his contention that it can be done, but clearly the public should not be asked, on the strength of sensational daily-newspaper articles, to subscribe the necessary funds to prove what the majority of technical experts regard with considerable doubt.—*Mechanical World*, of Manchester, Eng.

Redondo Junction Roundhouse, A. T. & S. F. Ry.*

Roundhouse of Attractive Appearance Built of Reinforced Concrete by the Unit Method.

A large number of reinforced concrete structures have been built by the unit method in recent years, and it seems the logical method for many types of buildings, notably where there are a number of exactly similar parts, so that the number of standard units may be cut to a minimum, and the maximum use made of each form.

The advisability of using concrete construction for locomotive roundhouses is suggested by the fire risk which is of course very great in a wooden structure housing locomotives. Non-fireproof locomotive houses are nearly always built with one or more fire walls, the latter being required by law in many locations. Due to the shape of a roundhouse and to the fact that the yardage of concrete is low per square yard of area covered, monolithic concrete has in general been found rather expensive for this purpose, although the elimination of fire walls is a feature which compensates considerably.

The adaptation of unit methods to roundhouses is interesting in that it seems to solve many of the problems. The Redondo Junction unit constructed roundhouse of the A., T. & S. F. Ry. has 25 stalls and ten pits outside, giving 35 pits, besides one set of truck and drive wheel pits. In addition, terminal facilities at this point are to include a machine shop, wood working shop, sand house, car repair shed, store house, power house, a roundhouse foreman's and engineers' supply building and a lavatory building.

The roundhouse has plain concrete foundations, and door sills cast in place, with concrete window sills resting on brick work as shown. Reinforced concrete columns and girders support the reinforced concrete roof slabs, and the walls are also reinforced concrete slabs with the exception of the brick work under windows. The doors and window frames are of wood. Floor consists of vitrified brick set on edge in grout, on a 3 in. concrete base.

Drainage is provided for by an 18 in. vitrified sewer pipe through end of engine pits along inner circle of house, connecting with a concrete catch basin with 9 in. walls.

A large portion of the wall is devoted to windows, which with the light color of the concrete gives a very light and airy interior. No doors are required in the roundhouse as the climate is mild the year around.

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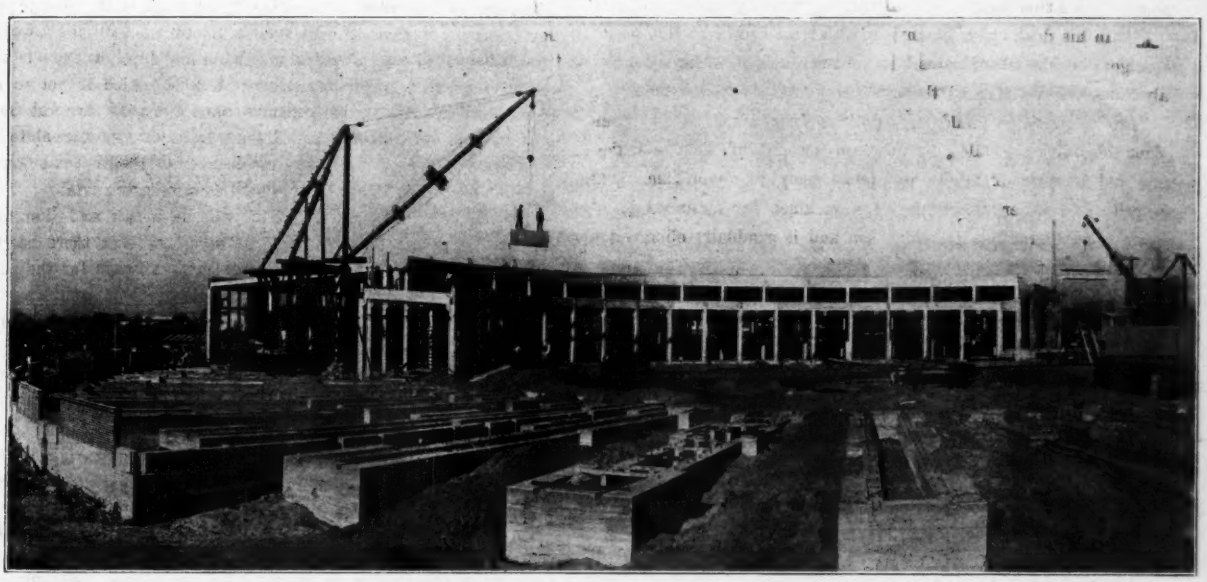
Design.

Loadings, Stresses, and Pressures.—Roofs were designed for a live load of 40 lbs. per square foot, as required by the Los Angeles building ordinance, and were tested by the City and by the Railroad company with a test load of 82 lbs. per square foot over an entire panel. The total load was 41,000 lbs. and the total deflection over the span of 23 ft. 6 in. was ⅛ in., as shown by the city engineer's report. All slabs and girders were figured as simple beams. The maximum loads are: on wall columns about 33,000 lbs.; on interior columns about 53,000 lbs.; and on columns on inner circle about 17,000 lbs.

The maximum compression allowed in concrete was 500 lbs. per square inch, and the maximum tension in steel was 16,000 lbs. per square inch. The soil pressure under column footings is about 3,500 lbs. per square foot. Soil was firm sand and gravel in deep layers and was easily good for 5,000 lbs. per square foot. No tests were made.



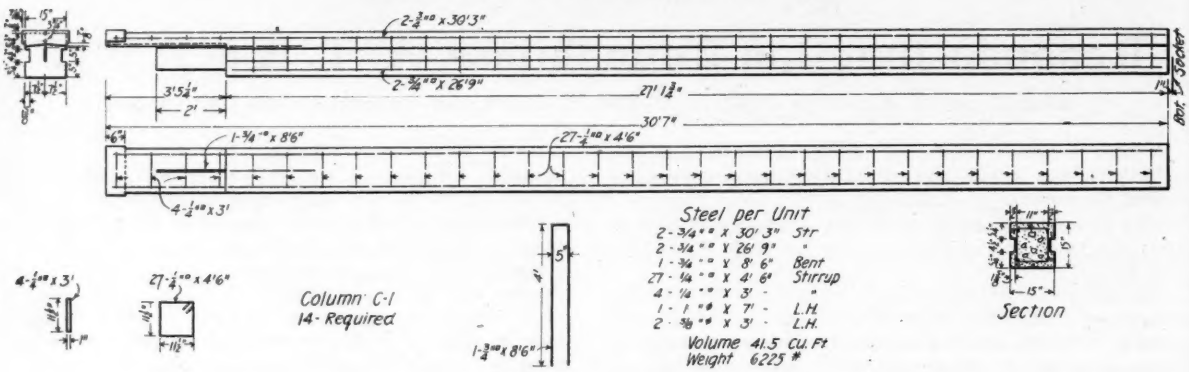
View of Redondo Junction Roundhouse Under Construction.

Foundation.—The wall slabs are carried on a continuous foundation wall 10 in. thick, around the outer circle of the entire house. The columns are supported on square piers. Footings are founded on a deep bed of firm gravel.

Columns.—The wall column, C-1, illustrates the method of keying the structure together. The two 4½ in. vertical slots receive the keys in the wall slabs, the whole being then grouted together. Corner columns have vertical keys and slots in adjacent instead of opposite faces, while interior columns are square.

The arrangement of reinforcing in C-1 is typical. A ¾ in. vertical bar is placed in each corner, two of these being 30 ft. 3 in. long, the other two being 26 ft. 9 in. long. The latter rods are in the side of the column, which is set back at the top as shown, to receive and support the girder G-1. This offset in the top of the column requires a change in the stirrups. Below the seat for the girder, there are twenty-seven ¼ in. square bar stirrups, 4 ft. 6 in. long, spaced on 4 ft. 6 in. centers. In the thin section above the seat, the stirrups are rectangular as shown, four being used, on 3 ft. centers. Round bars are used as hooks and loops to provide a hold for handling units after cast.

Girders.—We illustrate herewith girder G-1, which is a combination exterior wall girder and parapet. The cross section shows


Steel per Unit
2 - 3/4" ø x 30' 3" Str
2 - 3/4" ø x 26' 9" "
1 - 3/4" ø x 8' 6" Bent
27 - 1/4" ø x 4' 6" Stirrup
4 - 1/4" ø x 3' "
1 - 1" ø x 7' - L.H.
2 - 3/8" ø x 3' - L.H.
Volume 41.5 Cu. Ft
Weight 6225 #
Column C-1
14- Required
Section

Details of Column C-1.

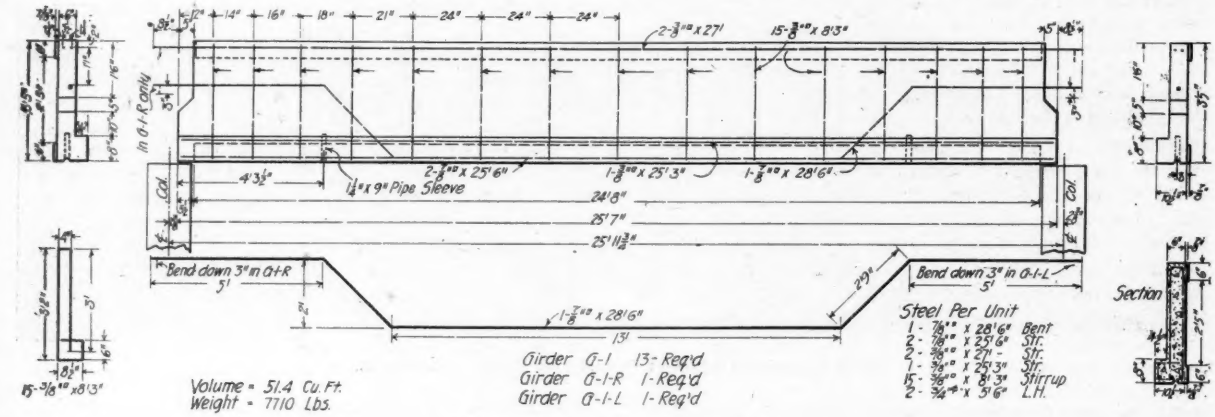
the seat for the wall slabs, and the elevation indicates the center line of columns and the positions of columns and girders in the structure.

This girder, which is eccentrically loaded by supporting roof slabs on one side only, is 6 in. wide at top, 3 ft. 5 in. deep, with a step or seat 8 in. thick projecting 4½ in. beyond inner base at the bottom, the span being 24 ft. 8 in. and total length 25 ft. 7 in.

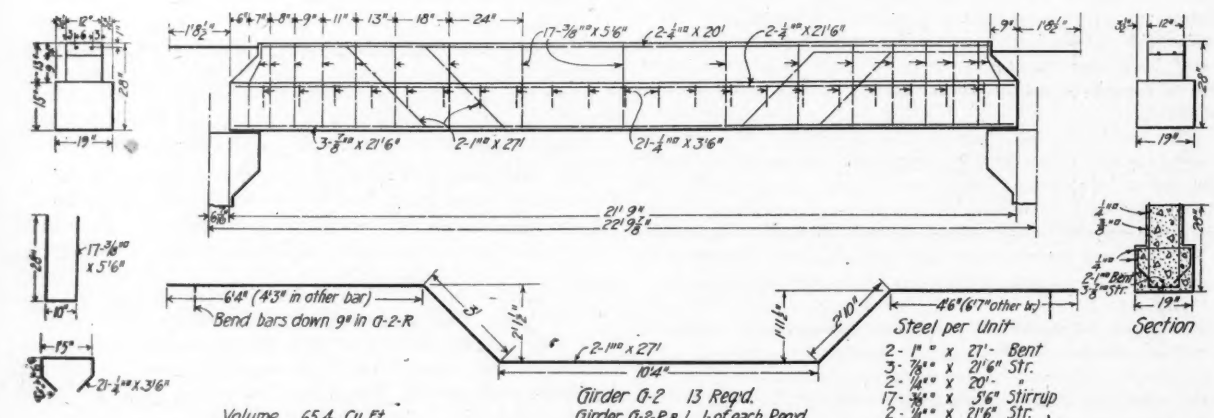
The horizontal reinforcing consists of two straight ⅜ in. square bars 27 ft. long in the top of the beam. Directly below these in the bottom of girder there are two ⅞ in. square 25 ft. 6 in. bars, one of which is bent up into top section at 4 ft. 3½ in. from end, as shown in illustration. A third straight bar, ⅜ in. square and 25 ft. 3 in. long, is located at the top of the roof slab seat, with a ⅞ in. square rod 25 ft. 6 in. long directly below it. The double stirrups, fifteen ⅜ in. square bars bent as shown in detail, are located on varying centers, from 12 in. at support, to 24 in. at center. These stirrups are intended to serve a double purpose, to resist shear in the vertical beam, and to resist the tension and shear caused by the load carried by roof slab seat.

The girder G-1, 21 ft. 9 in. long, 12 in. wide and 28 in. deep, is designed also as a parapet, which explains its depth and shape, and the ornamental cope at exterior bottom and top.

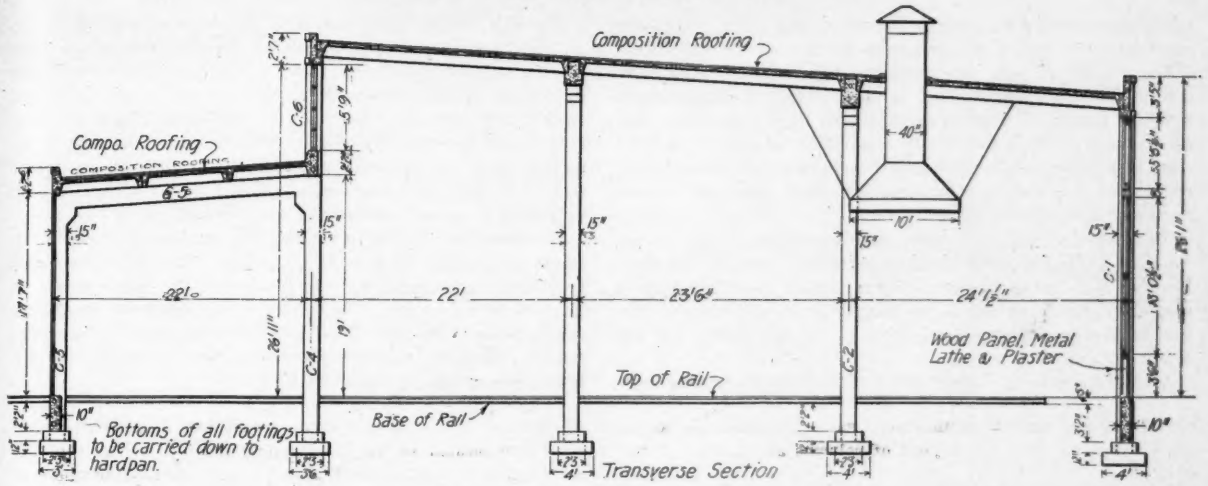
A typical interior girder is shown in G-2, which requires very simple forms as compared with girder G-1. The roof slab struts are carried on the 3½ in. seats, the loads on opposite sides being approximately equal. The main reinforcing is designed for a beam 12 in. wide, 28 in. deep, and 21 ft. 9 in. long. The projecting seats are the supports for the roof slabs. The two 1 in.


Steel Per Unit
1 - 7/8" ø x 28'6" Bent
2 - 7/8" ø x 25'6" Str.
2 - 7/8" ø x 27' - Str.
1 - 3/4" ø x 25'3" Str.
15 - 3/8" ø x 8'3" Stirrup
2 - 3/4" ø x 5'6" L.H.
Girder G-1 13- Req'd
Girder G-1-R 1- Req'd
Girder G-1-L 1- Req'd
Volume = 51.4 Cu. Ft.
Weight = 7710 Lbs.
Section

Details of Reinforcing of Girder G-1.


Steel per Unit
2 - 1" ø x 27'- Bent
3 - 7/8" ø x 21'6" Str.
2 - 1/4" ø x 20'- "
17 - 3/8" ø x 5'6" Stirrup
2 - 1/4" ø x 21'6" Str.
21 - 1/4" ø x 3'6" Stirrup
2 - 3/4" ø x 5'6" L.H.
Girder G-2 13 Req'd.
Girder G-2-R & L 1- of each Req'd
Volume 65.4 Cu. Ft.
Weight 9810 #
Bend bars down 9" in G-2-R
Section

Details of Girder G-2.



Cross Section of Roundhouse.

square bars 27 ft. long in the bottom are bent up into top of beam as shown in the elevation. The three ⅞ in. square bars 21 ft. 6 in. long in the bottom, are straight bars.

The top of the beam is reinforced by two ¼ in. square, straight bars 20 ft. long, while the seats each have near the corner, one longitudinal ¼ in. square straight bar 21 ft. 6 in. long.

The twenty-one ¼ in. square stirrups 3 ft. 6 in. long, are bent as shown in detail and are designed to care also for stress in the lower portion of beam due to roof slab loads on seats. The bends at the ends of these bars gives increased resistance to the tension developed. The spacing of these short stirrups is indicated in the lower part of the elevation of girder.

The seventeen ⅜ in. square stirrups 5 ft. 6 in. long are bent as shown, and are spaced on varying centers from 6 in. at support to 2 ft. 10½ in. at center.

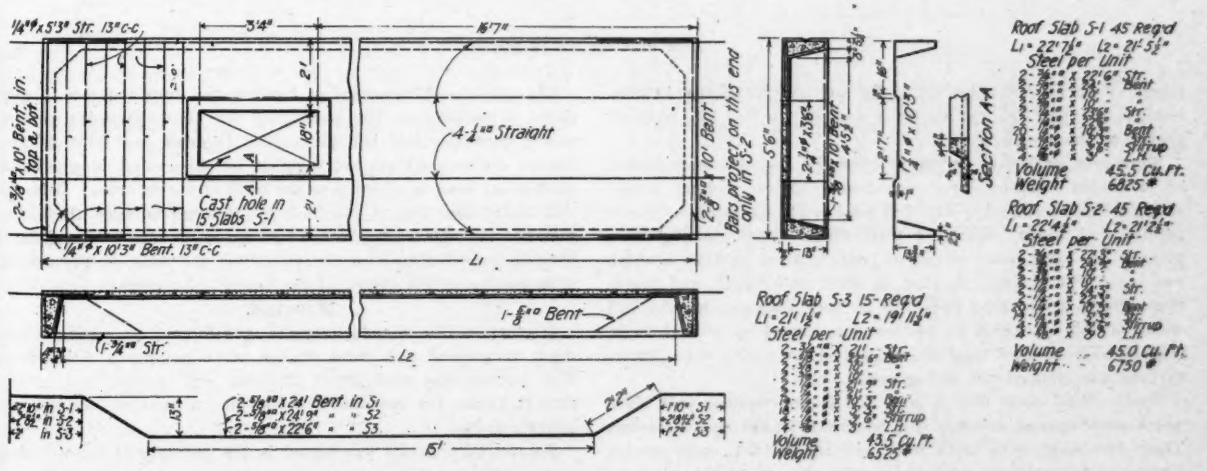
Roof Slabs.—A typical roof plan is shown herewith which illustrates the construction and method of assembling and order of placing the slabs and girders. The girders are erected in the order indicated, G-1, G-2, G-3, G-4, G-5 and G-6, the girders at the inner circle having been completed previously.

Slabs S-1, S-2 and S-3 have the same width and thickness, but the lengths are respectively 22 ft. 7½ in., 22 ft. 4½ in. and 21 ft. 1½ in. In the section of roof shown, which covers three stalls, there are 12 different sizes of slabs, each with a thickness of 3 in., the total number of roof slabs in this section being 46. Over a single stall there are 16 slabs and 12 different sizes. The use of several duplicate slabs in each section, of course reduced the work of design, reduced the number of different sized forms necessary, and this reduction makes the assembly and construction easier and less costly.

The arrangement of the roof slabs seems especially economical, and shows the adaptation of this type of structure to circular buildings. The assembly is exceedingly simple and easy to understand, especially when compared with the plans for a steel frame or other type of building.

The arrangement of girders is shown in the part roof plan. The spans between girders are taken care of by struts 15 in. deep cast integral with the slabs. This is shown in the sections taken through slab S-1. The reinforcing in the bottom of the longitudinal strut, 15 in. deep, in slab S-1, which is typical, consists of the following: one ¾ in. square straight bar in the bottom of each girder section, one ⅝ square rod bent up into top of slab with a 2 ft. 2 in. bend at the point shown; the latter bars project 11 in. beyond end of slab and are bent over and tie to bars cast into the girders G-1. At the opposite end, which is an interior joint in the structure at G-2, the projection is 1 ft. 5 in. In the top of strut, in each corner, there are ¼ in. square, longitudinal straight bars 23 ft. 6 in. long, the other 22 ft. 6 in. long. Each transverse slab strut, 15 in. deep, is reinforced by two ⅝ in. bars 10 ft. long, one in top and one in bottom, bent as shown in the detail.

In the slab proper, 3 in. thick, the transverse reinforcing consists of nineteen ¼ in. round rods 5 ft. 3 in. long on 13 in. centers, alternated with twenty ¼ in. round rods 10 ft. long bent similarly to those in the end struts, these also being on 13 in. centers, making the net spacing 6½ c. to c. The longitudinal



Plan and Sections of Roof Slabs S-1, S-2, S-3.

reinforcing consists of four ¼ in. square rods, two at extreme edges, and two located one foot from the bars at the extremities.

The number of bent bars used, and the bending details show how the slabs are tied together so that the full bonding strength would be developed, which is essential with these 3 in. slabs. The arrangement of the bends in bars is such that the stress is in every case in the opposite direction from the thinnest concrete covering, and the tension developed cannot break out a small strip of concrete and thus expose the bar.

The design of the other slabs is quite similar to that of S-1, the slabs being 3 in. thick, with 15 in. struts. Some of the slabs, however, had to be designed wedge shaped, thus requiring a somewhat greater variety in the lengths of transverse bars. The spacing is also different, being 9 in. net in the slabs S-4-R and S-4-L.

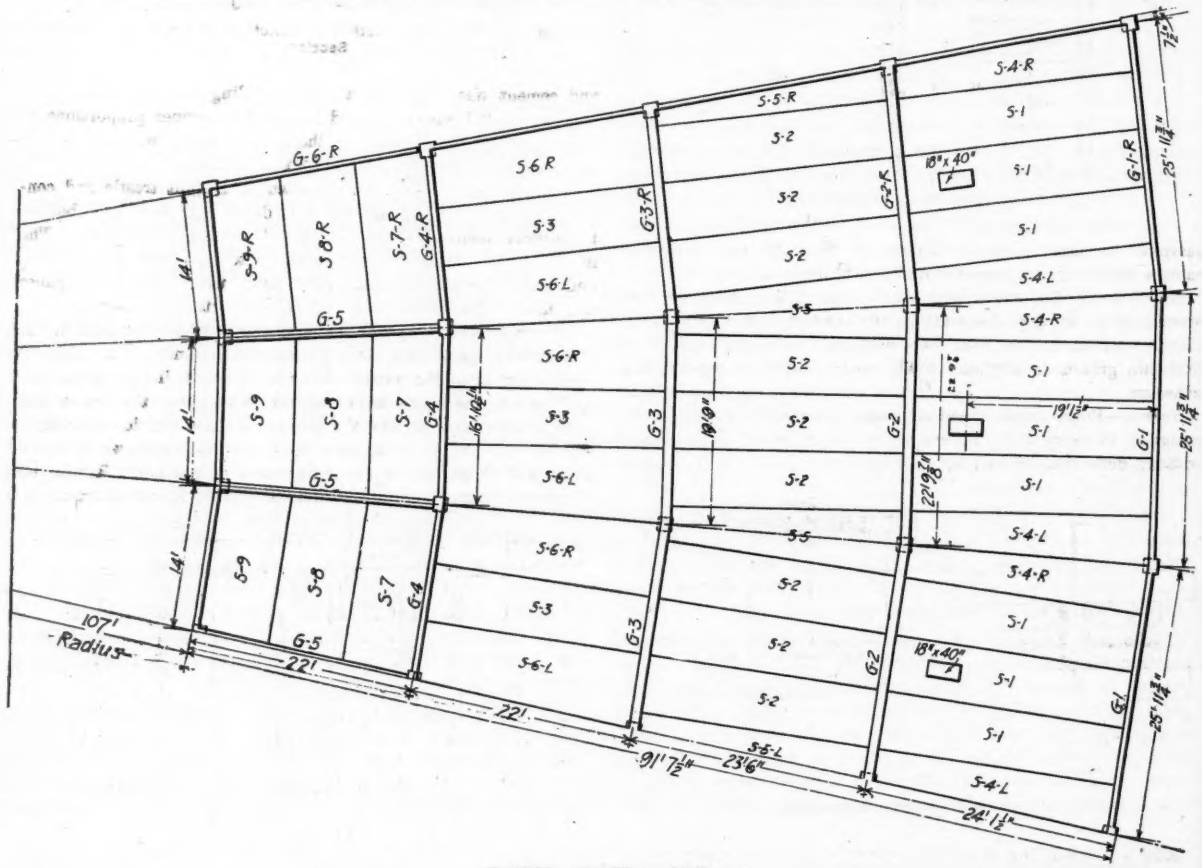
Roof Waterproofing.—Roof waterproofing consists of four thicknesses of tarred felt weighing 14 lbs. per 100 ft. square, 120 lbs. straight run coal tar roofing pitch and 300 to 900 lbs. screened gravel, to the square.

Work was started at gutter or eaves by laying one thickness, 32 in. width. Second layer was folded double, making second strip 16 in. wide, moping with hot pitch. Then a third layer was applied full width, making 4 thicknesses. Then starting at a point 16 in. back, which is end of four-thickness portion, a width was layed 7½ in. back, moping on sheet underneath, and operation continued, dropping back 7½ in. each time and moping full width of lap. A three in. portion was turned up at end walls, mopped and cemented together, and nailed down with lath. Entire surface was mopped hot and graveled.

Walls.—Wall slabs W-1-K and W-1-L are vertical wall slabs which abut against columns C-1, as shown in the rear elevation. These two slabs, with brick work and column C-1, make up the standard rear walls for each stall, up to the top of the windows.

The slab W-1-R, 8 in. thick, 4 ft. 3¾ in. wide and 22 ft. 7½ in. high, has a vertical post 6 in by 10 in. at the left to form reveals, and window casings. The 8 in. slab is reinforced vertically by four ¼ in. square bars 22 ft. long, two placed near right end of slab, one near each base, the other two being similarly placed near the center of width of slab. The end post has four ⅝ in. vertical bars, one in each corner as shown. Two ⅝ in. square stubs 2 ft. long are placed one at top and one at bottom of post, projecting 4 in. to provide bond when erected.

Horizontal reinforcing in the end post consists of fifteen ¼ in. stirrups, 2 ft. 6 in. long, on 18 in. centers. The slab is reinforced horizontally near each face with fourteen ¼ in. square rods 4 ft. long, on 18 in. centers. The volume of the slab is 37 cu. ft., the weight being 5,550 lbs. The design of other slabs is somewhat similar, details of reinforcing being changed somewhat, but following the method indicated on W-1-R.



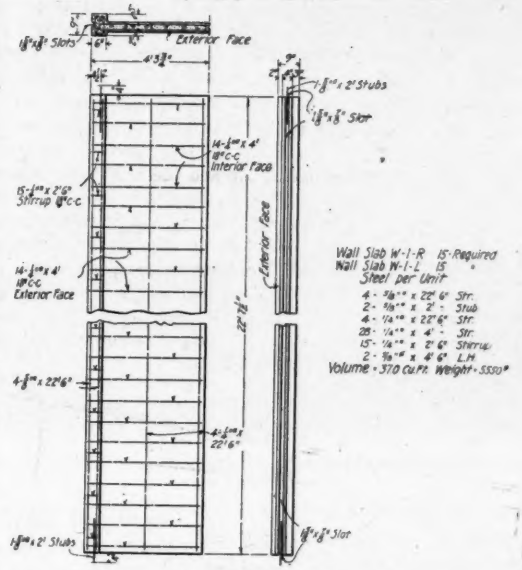
Roof Plan for Three Stalls.

Connections.—The method of bonding the units together is well shown in the details. The protruding bars of two opposing girders and a corresponding bar protruding through each side of the column are securely clipped together by cable clips, to provide a mechanical bond in addition to the bond of the concrete. Between roof slabs, the bond is provided by grouting between the slabs, each of which has a key about 3 by 1 in. in the side. Over girders, bond is provided by clamps applied on the ends of protruding bars, similar to the design of the beams at columns.

Materials.

Mixtures.—The foundations are 1:3:5 concrete, using clean sharp river sand and clean broken stone passing a 2 in. ring. The concrete was made fairly dry, was well tamped, and spaded next to forms, the specifications requiring a good surface without honeycombing.

Reinforced concrete was mixed in the proportions 1:2:4, using stone passing a 1 in. screen. Stone passing a ⅛ in. mesh was

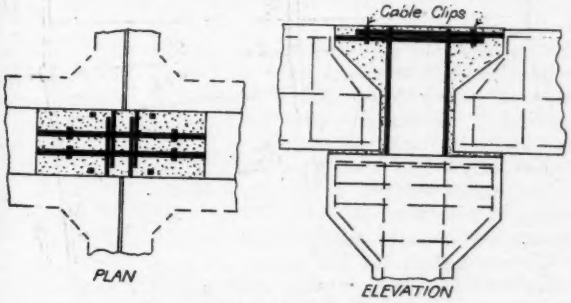


Wall Slabs W-1.

accepted as sand, if clean. Reinforced concrete was made wet enough to flow freely into crevices and around bars.

Reinforcing.—Deformed bars meeting the requirements of the specifications of the Association of American Steel Manufacturers were used, and bars were required to be clean of dirt, dust, oil, grease, or anything which would destroy or weaken the adhesion.

Forms.—Forms were made of select Oregon pine, and were designed to carry the full weight of the concrete as a liquid, without deflection or bulging.

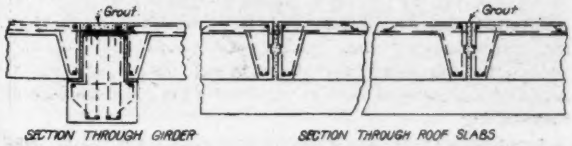


Girder and Column Connections.

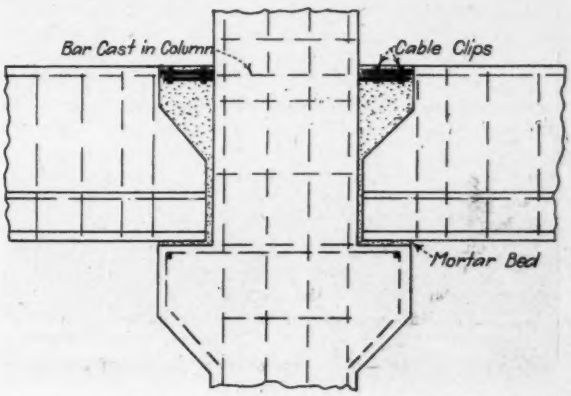
Roof slabs S-1, S-2 and S-3 have the same width and were all cast in forms built for slab S-1, which is 22 ft. 7½ in., while S-2 is 22 ft. 4½ in. and S-3 is 21 ft. 1½ in. long. The only adjustment necessary was to move the end wall of the form in 3 in. when pouring slabs S-2, and to move the end wall a further distance of 1 ft. 3 in. in when pouring S-3.

Construction.

Concrete Plant.—The units were cast in a yard adjacent to the roundhouse. The concrete plant was a stationary one, consisting of a mixer and engine mounted on a pile trestle. Sand and stone were unloaded directly on the ground from railway cars,



Connections Between Roof Slabs and Between Roof Slabs and Girders.

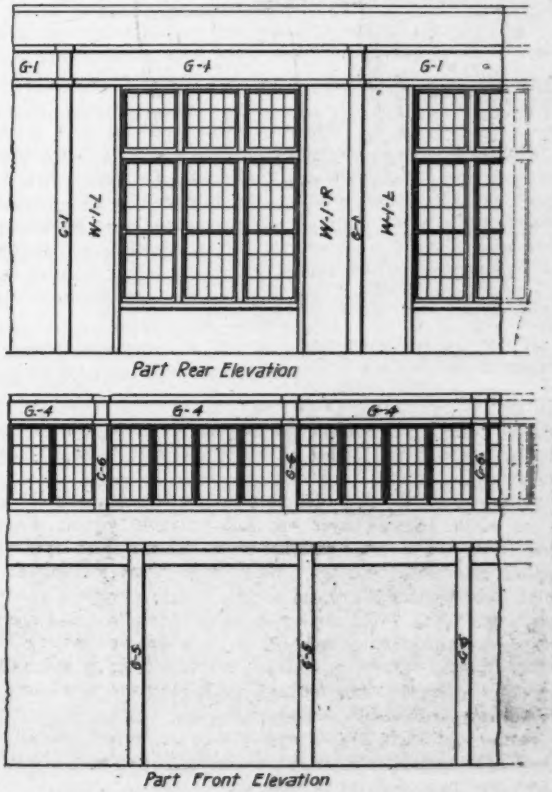


Column and Girder Connection at Junction of High and Low Roof Section.

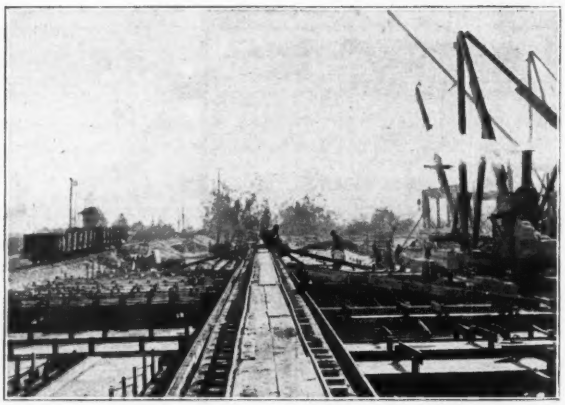
and cement was stored in a small building on the trestle. The stone and sand were delivered by hand in proper proportions in wheel barrows to a hopper on the ground, which was then pulled up an inclined track and dumped in the mixer.

A narrow gage track was mounted on a light trestle and concrete was delivered by narrow gage dump cars with steel bodies, to slightly inclined chutes which led down to the forms. The incline of the chutes was not sufficient to carry cement to forms, and same was shoved and pulled down the chutes with spades and hoes. The forms were securely mounted on heavy timbers which were levelled up and founded firmly to prevent settlement. The narrow gage cars were propelled by hand. The members were taken from the yard to the site of the building by locomotive cranes, the crane removing the units from the forms and placing them on flat cars for delivery to the erection derrick.

From four to six boxes were made for each unit, which would mean that about nine to six units were cast per box. Herein lies



Part Elevations of Front and Rear of Roundhouse.



General View of Casting Yard, Showing Narrow Gage Track Leading from Mixer.

one great advantage of unit construction: the consecutive use of these boxes is made without taking the lumber apart and building it up again. In building a monolithic building, the form lumber is used a number of times, but every time it is used it becomes rougher on account of renailing and splitting, consequently giving a non-uniform and progressively poorer surface finish.

Erection.—The erecting was done by stiff legged derricks moving on rollers, the latter supported on timber stringers laid across the tops of the pit walls. Two derricks were used, working away from each other, starting near middle of roundhouse. The second derrick was not started until the first one had progressed far enough to prevent any interference. In the photograph reproduced, one derrick is just completing an end of the house, while the other has seven stalls to erect. Note that swinging boom is mounted on derrick tower at a point above the elevation of high part of roof. The boom never was interfered with by the building, even after fully erected.

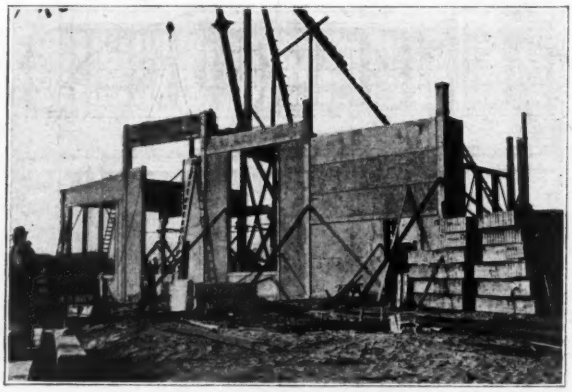
Hooks or loops were cast in each unit to facilitate handling by the crane and derricks. These loops were short, round rods, as indicated in the tables of bars on the diagrams of the different units illustrated herewith.

Surface Finish.

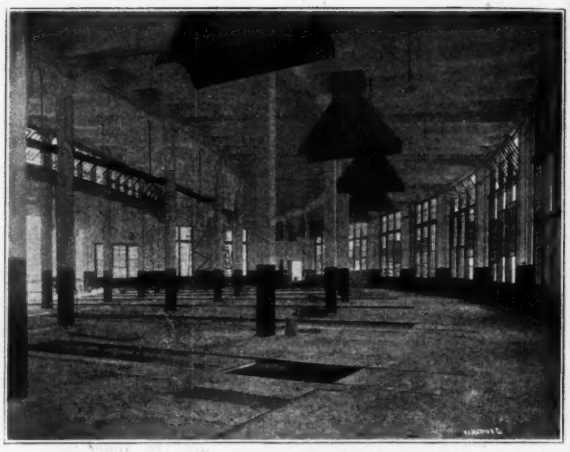
The forms were made of select Oregon pine. The exterior surfaces were cast upward and floated off. The forms were surfaced and oiled before pouring, and the concrete was carefully tamped and spaded. No other finish was given, very smooth surface being obtained in the original casting. Specifications required all rough places to be smoothed off, and especially required that the roof slabs be smooth for receiving the composition roofing.

Costs.

It may be estimated that the cost of temporary forms for structural concrete now averages from one-quarter to one-third of the total cost of the structure. This is due to the constantly increasing price of lumber and the unsatisfactory results obtained by standard steel forms for monolithic construction.



Tower Derrick Erecting Coping Girder. Units in Storage.



Interior of Riverbank Roundhouse—Same General Construction as Redondo Junction.

The cost for the unit type roundhouse is somewhere between a concrete wall and wood roof building and a monolithic concrete building. The type as described herein runs from $2,500.00 to $2,600.00 per stall. This figures at about 6 cents per cu. ft. and $1.40 per sq. ft., including engine pits. Each set of truck and drive wheel pits cost $506.00.

Comment.

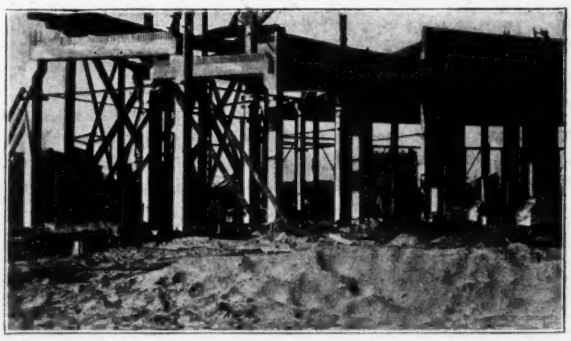
By the separately molded method the shrinkage takes place before the member is in position, and the best of opportunity for properly taking care of temperatures stresses and expansion is afforded by the large number of joints between the field and previously molded concrete, among which the total movement, if well distributed, makes the movement at any single point nearly negligible.

In addition the separately molded members can be surface finished within a few hours after being cast. This subject of finish of concrete is one that is becoming of more and more importance. On structures where the forms must be left on for weeks after the members are cast, it is difficult to finish the surface satisfactorily and yet economically.

The exposed surfaces of the unit members can be given a variety of treatments, and by the proper selection of aggregates the appearance can be made as artistic as the cost will allow.

The unit method also has another advantage in the speed in which buildings can be erected. This is often a very valuable consideration where replacements are being made, or where the work is needed in a great rush.

The strength of steel in tension is what ties a building together and not the tensile strength of the concrete. The basis of theory of design for concrete and steel is the bond between concrete and



Front View During Erection, Showing Sequence of Erection Operations.

steel. Therefore, to construct a building of previously molded units, it is only necessary to work out the details of connection to insure a proper bond of the steel.

The structure described and illustrated herein gives an excellent idea of the adaptability and pleasing appearance obtained by this type of construction.

Personnel.

The Redondo Junction roundhouse was designed and constructed under supervision of G. H. Harris, chief engineer of the Atchison, Topeka & Santa Fe, Coast lines. The design was made and the construction carried out by the Van Sant-Houghton Co., San Francisco, Calif., Pacific representatives of the Unit Construction Co. of St. Louis, the latter company controlling unit construction through a number of patents. We are indebted to the above for the information, plans, and photographs used herein.

1,100,000-BUSHEL GRAIN ELEVATOR.

The Pennsylvania Railroad will on July 1st, place into full operation its new 1,100,000-bushel grain elevator at Girard Point, Philadelphia.

The new elevator was built at a cost of $1,200,000. It is made entirely of concrete and steel, and the facilities it affords are unsurpassed in scientific practice. It is expected to prove the most rapid plant ever built for transferring grain from rail to water.

The new elevator is located at the mouth of the Schuylkill River within a few hundred yards of the main channel of the Delaware River. The elevator proper sets back 500 feet from a pier 900 feet long, on both sides of which vessels can dock. Grain will be delivered to ships for export by a conveying gallery, which extends out to the end of the pier.

The elevator has an unloading capacity of 240 cars per day of ten hours. It has sufficient trackage to accommodate 400 cars. The capacity and flexibility of the receiving and shipping plant is further increased by a six-track concrete shed, two cars long, permitting the unloading of twelve cars at once. The shipping gallery has a capacity for loading ocean steamers of 650 feet length, at the rate of 60,000 bushels per hour.

In general the elevator plant consists of a working house for the machinery, track-shed, storage house or annex, and conveyor gallery, pier, power house and drier. Grain is received in the track-shed receiving pits, and after unloading is carried to one of four receiving elevator legs and elevated to the garner over a receiving scale, from where, after weighing, it is spouted to bins in the working house for cleaning or shipment to vessels, or is carried on a conveyor belt to the annex for storage. Shipping facilities to vessels are provided by four belt conveyors from the working house to the pier.

The new elevator is equipped with one of the largest grain driers in the country. It has a capacity of 3,000 bushels per hour. The plant also has the four largest grain cleaning machines in the country; 20,000 bushels can be cleaned in one hour.

To the east of the working house and connected to it by a concrete tunnel and bridge is the storage annex, consisting of fifty-four 13,000-bushel reinforced concrete circular tanks with a basement and cupola. The forty intermediate spaces have a capacity of about 3,300 bushels each. The storage annex has a capacity of more than 800,000 bushels.

The Boston & Maine has prepared plans for a double track bridge over the Hudson river at Saratoga Junction. The contract for the work has not yet been let.

The Boston & Maine has ordered 200 tons of bridge material from the Boston Bridge Works.

Agreements regarding the proposed union station at Quebec, Que., were completed some months ago, but a difficulty arose over the purchase of some land and this delayed matters, but it is now expected that the Canadian Pacific will call for tenders at any early date. The station will be built at the Champlain market at an estimated cost of $70,000.

The Illinois public utilities commission has approved plans of the Union Station Co. for its new terminals at Chicago. The project is temporarily held up pending negotiations between the Chicago & Alton and the other lines over the transfer of property of the Alton. The station company needs this property before its plans can be carried out.

The Carolina, Atlantic & Western, Hamlet, N. C., is reported as preparing to construct a bridge across the Cooper river.

Application has been made to the war department for permission to build a draw-bridge over Cooper river, near Strawberry ferry, on the line being built by the Charleston Northern between the city of Charleston, S. C., and Andrews.

The Chicago Great Western has awarded contract to Roberts & Schaefer for three 100-ton reinforced concrete coaling plants, for installation at St. Joseph, Mo., Carroll, Iowa, and Kenyon, Minn. Also a 50-ton capacity frame coaling station at Red Wing, Minn.

The Chicago, Milwaukee & St. Paul, it is reported, will rebuild the old Grand Ave. viaduct over Menominee Valley.

The Chicago, Rock Island & Pacific has awarded a contract to the Gould Construction Co. for bridges on the second district of the system.

The Cincinnati, Bluffton & Chicago contemplates the erection of a bridge over Wabash river, near Bluffton, Ind., on the site of the bridge recently destroyed.

The Grand Trunk is preparing to start work soon on the construction of the Toronto union station, which was projected some time ago. Plans for the proposed structure are not yet completed. It is to be built jointly by the Canadian Pacific and the Grand Trunk.

The Lexington & Eastern (Louisville & Nashville line) has completed plans for construction of a railroad bridge over the north fork of Kentucky river near Hazard, Ky.

The Duluth, Minn., City Council, approved plans of the Minneapolis, St. Paul & Sault Ste. Marie for the trestle from the approach of the Interstate bridge to the tracks of the Duluth Terminal. The cost of the structure will amount to $750,000.

The New York, New Haven & Hartford has given a contract to C. W. Blakeslee & Sons, on a unit price basis, for the foundations of an overhead passenger station to be built at Pawtucket-Central Falls R. I. dividing line. The new station is to be of brick, stone and concrete construction, with a main building 84 ft. x 162 ft., with two wings 32 ft. x 60 ft. Bids were recently opened for the steel work; other contracts have not yet been let. The cost of the improvements will be $224,000.

The Northern Pacific has awarded contract for the construction of a round house, shops and other terminal buildings at Lewiston, Idaho, to the E. J. Rounds Construction Co., Seattle, Wash., at an estimated cost of $70,000.

The Northern Pacific has placed an order for a viaduct over Green river, calling for 2,450 tons structural steel.

The Pennsylvania R.R. is expected to place a 2,100-ton structural steel contract for bridges over Schuylkill river.

Bids have been received from the contractors for the construction of the proposed new Dallas, Tex., union station. The contract is expected to amount to approximately $4,500,000, including the new station and auxiliary buildings.

The receivers of the Pere Marquette have awarded contracts to the Roberts & Schaefer Co., Chicago, for two 100-ton concrete coaling stations, for installation at Blenheim, Ont., and Port Huron, Mich.

Bids are being received by the Pennsylvania Lines West for the construction of a new passenger station at Canton, Ohio. The building is to be used solely for station purposes, and is to be of brick and terra cotta, with a main facade 145 ft. long. The main waiting room will be 50 by 62 ft. and 30 ft. high.

The Seaboard Air Line is reported as planning extensions to its shops at Portsmouth, Va.

Track Scales*

(This report is rather voluminous to review and give any fair conception of its contents within the limits of space available for a review. It covers 167 pages of the Proceedings. It gives 19 pages to a history of weights and early weighing and 12 pages to description of present day track scales as made by the different scale companies. It calls attention to the fact that while track scales were in service as early as 1850 that it was as late as 1870 before they were generally used, the railroads up to that time having used the steamship method of rating 40 cubic feet as a ton. The resulting losses to the roads of that time are amusingly depicted. The importance of track scales is illustrated by the fact that three-fourths of the tonnage of the railroads is measured by them, while two-thirds of the gross revenue comes from freight, and the report estimates that forty per cent of the gross revenue of the roads is measured by the track scale. If the track scale be out of order, it gives weights less than the actual in nine cases out of ten. The report does not mention a further fact, that the shipper never makes complaints of the underweights. The track scales of the country each measure an estimated average of over three hundred thousand dollars per year of gross revenue.) The following illustration is used:

"Each track scale weighed 8,300 cars and measured $332,000 of revenue. If the scale weighed this amount one-tenth of one per cent less than the actual, the road owning it was loser to the amount of $332. If a scale weighs a car weighing 32,000 lbs., and its contents weighing 40,000 lbs., one per cent less than the actual weight, it is giving more than double this error. If it weighs such cars 400 lbs. short, it gives a loss of revenue of one per cent. This will pay for an average scale every year and for a very high class scale every two and a half years. The cost between a faulty installment and a good one is about half this estimated possible yearly loss. Ask your scale inspector how the scales on your road average!"

The following costs of track scales installed are given, furnished by the roads installing:

Cost of 46-foot 100-ton scale on L. S. & M. S.:

Excavating	$ 40	
Concrete work and material	250	
Scale complete, including I beams	696	
Platform and beam box	76	
Hardware	18	
Labor erecting	120	
Drainage	60	
Total	$1,260	

Cost of Santa Fe standard scale at Los Angeles, Cal.:

Material.		
Scale and 5,100 lbs. structural steel	$1,325	
Other iron and steel	230	
160 bbls. cement	160	
75 yards crushed rock	75	
Piling	180	
Mill work, etc	241	
Graphite and paint	37	
Hardware, etc.	115	$2,363
Labor.		
Excavating	$ 50	
Driving forty piles	140	
Installing scale	1,000	
Electricians	35	
Building scale house	75	
Painting scale	35	1,335
Total, material and labor		$3,698

*Condensed abstract from the report printed in the Proceedings of the American Railway Bridge and Building Association.

200-ton 67-foot scale on P. & L. E. at Glassport, Pa.:

Concrete foundations	$1,101
Excavating scale pit	334
Sewer	181
Steel frame	3,059
Scale	2,000
Rails and track work	565
Placing frame and scale	548
Engineering and inspection	264
Electric light wiring	20
Total	$8,072

The following is given as indicating what a track scale should be: "A track scale is both a bridge, over which heavy loads are carried, and a delicate mechanism by which a large portion of the revenue of a railroad is measured."

Sensitiveness.

Observation of all types and makes of track scales in various parts of the country indicates that it is a mistake to require too great a measure of refinement in the track scale. The comparatively blunt edge of a cold chisel will cut that which no keen-edged knife will. A track scale designed as sensitive as an assayer's scale (which it is claimed will show a difference

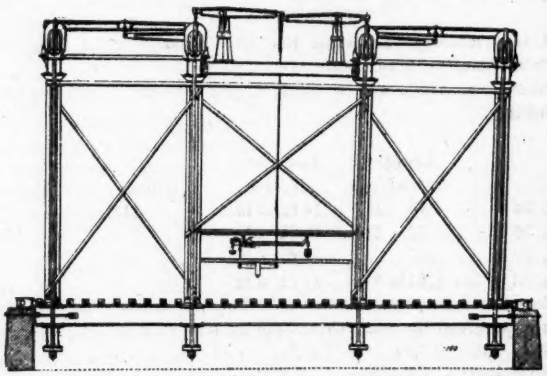


Fig. 34. Suspended Type Track Scale.

in the weight of a sheet of paper before and after a signature has been written on it) would be ruined by the first car weighed. Experience indicates that if a scale is graduated to weigh 50 lbs. on the secondary beam, and is sensitive to half this amount when new, better results will be obtained than if greater sensitiveness is sought. This rule is empirical, but is derived from tests on wear of knife edges. If a knife edge breaks or wears, it destroys multiplication at that point and produces a constant, cumulative error. The American Railway Association recommends that the scale weigh correctly to 100 lbs. at any time during its life, and be sensitive to 50 lbs. when new.

Overhang.

Figure 35 represents a scale with no overhang. The pair of wheels of the oncoming car "falls" across the opening and the whole weight is precipitated directly on the end bearings, with a leverage equal to the distance from the joint opening to the pivot, increasing the loads by perhaps 12 per cent. This also has a tendency to lift the bridge off of the second bearings, which it has been claimed injures these bearings. Figure 36 shows the opening directly over the end bearings, as in the designs of the B. & O. R. R., the Penn. R. R., and others. This design is said by some to be injurious to these end bearings, but relieves the lifting off of bridge from second bearing. Figure 37 shows opening placed to increase overhang to make it come at a point one-sixth, one-fifth or one-third the distance to the

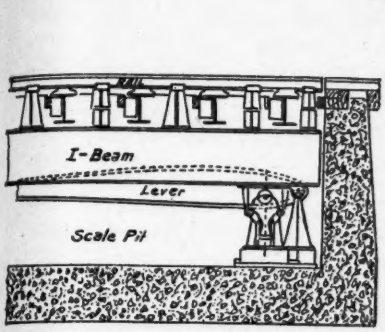


Fig. 35. Showing No Overhang.

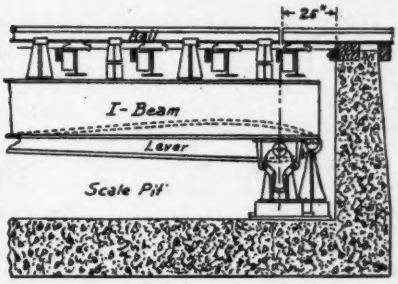


Fig. 36.—25 In. Overhang.

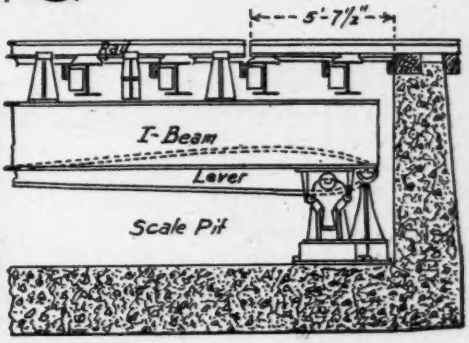


Fig. 37. 5 ft. 7½ In. Overhang.

second bearing. This design used by the B. & L. E. R. R., Carnegie Steel Co., and others, distributes the shock on two bearings, and the resiliency of the track support absorbs some of the shock before it reaches the knife edge. This design requires a long section and increases the cost of levers and weigh bridge. Figure 38 shows an overhang as used in some six section scales. It distributes the load evenly on the two bearings and has the other advantages of type illustrated in Figure 37.

Figure 38 shows a typical drop bottom gondola, which is short and produces concentrated loads on scales. With the maximum load of 22 tons for the car and 55 tons for the load, an axle load of 38,500 lbs. will be produced.

Comparison of Scales.

It is customary to assume that the impact on the joint to be twice the axle load. Assuming this to be true and assuming Figure 36 as 100% and a basis of comparison, we obtain the following:

	Length of Scale Irons.	Length of Section.	Force of Blow, %	Injury from Blow, %
Fig. 35	46 ft.	14 ft. 2 in.	112	117
Fig. 36	50 ft.	15 ft. 4 in.	100	100
Fig. 37	57 ft.	17 ft. 8 in.	80	72
Fig. 38 (6 Sec.)	61½ ft.	11 ft. 6 in.	50	33

Computations show somewhat different results. The injury was determined by using sheet lead on a small number of scales.

With axle loading of 38,500 lbs. as shown in Figure 39, loads on first section were figured as follows: (A) when first pair of wheels falls across opening; (B) when second pair of wheels falls across opening (load on second section in Figure 38). Column C, below, shows the load on any intermediate section when two loaded cars are being pushed across the scale and the scale section or bearing is directly below the center between the two cars.

Concentrations caused by 50-ton loaded gondola with 100% impact:

	A	B	C
Fig. 35	86,000	117,500	89,500
Fig. 36	77,000	102,000	94,000
Fig. 37	62,000	81,000	103,000
Fig. 38	38,500	76,000	74,000

These figures will be changed if length of scale rails is changed, and are given only for comparison.

The question arises as to which method to pursue; to design

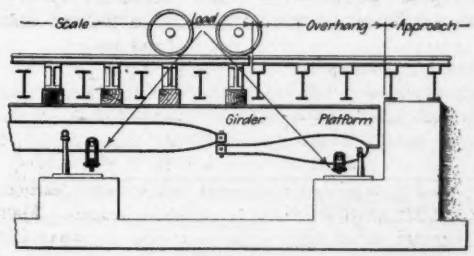


Fig. 38.

knife edges, levers and parts for a load of 60 tons with Figure 65; to use an imposed load of 52 tons with Figure 36 and 37; or to use 40 tons with Figure 38, using the same factor of safety throughout. With a view to shedding light on this subject, the following percentages of weights were figured for the four types, using the rules of the American Railway Association as far as they went and good bridge practice for the balance, to obtain these weights:

	Weight of weigh bridge (per cent)	Weight of scale parts (per cent)	Length of bearing parts (per cent)
Fig. 35	72	76	113
Fig. 36	82	82	98
Fig. 37	100	100	100
Fig. 38	86	82	108

This table indicates that there should be no great difference in the costs of the several types except as influenced by difference in overhead expenses of concerns making the scales. The overhead would be high for a design if new patterns must be made without an assurance of future demand.

Additional Stresses Due to Thrust

A longitudinal thrust is caused by stopping or starting a car on the scale. If there are a number of cars between it and the locomotive, the car will be jerked or bumped to a start or a stop, while a car next to the locomotive will be started and stopped gradually. This shock has been assumed at one-fifth car weight or 30,800 lbs. in the above. It is very necessary that the device for absorbing this should be strong enough to accomplish its purpose, and should prevent too great an oscillation. Check rods, if used, should be kept level. A 24-in. check rod 1 in. out of level might bind enough to change weight indicated on the beam nearly 1,000 lbs.

Steel for Knife Edges and Bearings.

The steel for knife edges and bearings is discussed. Strangely in this discussion the Composite Steel, made in Sheffield, England, is barely mentioned. It is also mentioned in the discussion by Mr. Bousfield, but the paper carries the inference that this steel is still in the experimental stage of manufacture, which is not true.

Weigh Bridge.

The weigh bridge of the scale is discussed briefly, much less than its importance warrants.

The weigh bridge is of as much importance as the scale mechanism. It must be designed with sufficient strength to prevent the transmission of vibration to the scale mechanism. The weigh bridge is a girder and therefore should be designed by a bridge engineer familiar with the service it is to perform.

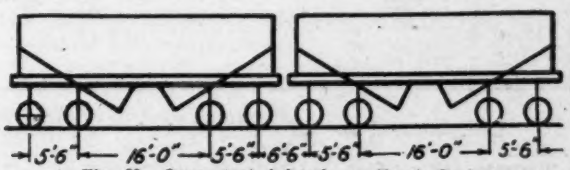
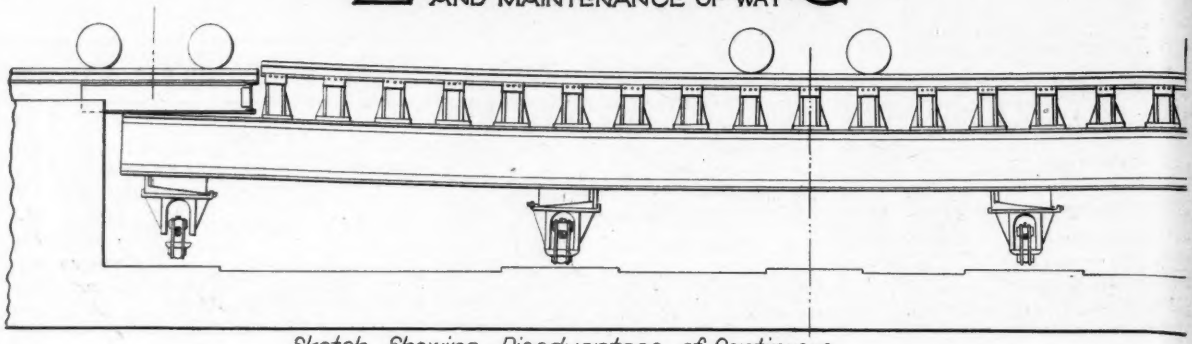


Fig. 39. Concentrated Loads on Track Scales.



Sketch Showing Disadvantage of Continuous Girders on account of Upward Deflection at Ends with Load on Intermediate Section.

Figure 42-A.

A very heavy weigh bridge is used by the Pennsylvania R. R., the installations of that road embodying the best practice in the use of ordinary girders. In the newest installation of a very heavy four-section scale on the N. & W. Ry., a hinged girder, called the Wentworth girder, is used. There is always an upward deflection at the ends of a continuous girder, as illustrated in Figure 42-A, while the hinged girder in Figure 42-B is claimed to eliminate this objection.

Scale inspectors feel that these weigh bridges, even when carefully designed and accurately set, will be affected by changes of temperature, and that the continuous girder is not always in such shape as to distribute stresses equally to all bearings.

(It might be said here that taking the loading as shown in Fig. 50 of this report, and assuming a wheel load of 20,000 lb., the reactions on the sections will be as follows for the different length of span as between the continuous weigh bridge and the articulated:

Length of span between sections.	Reaction on Section A. Articulated.	Continuous.
14 ft.	45,714 lb.	58,464 lb.
16 ft.	50,000	63,816
18 ft.	53,331	66,252
20 ft.	56,000	68,690

Typical Scales.

(The report then gives illustrations of some typical scales. The Pittsburgh and Lake Erie six-section scale with an overhang of the platform so the load comes on the scale midway between the first two bearings; the Bessemer and Lake Erie four-section scale which gives an overhang sufficient to deliver the load one-fifth the distance between the first two sections; the Southern Ry. scale which delivers directly above the end section; the Illinois Central scale which delivers outside the end section; and the Chicago & Alton Ry. scale, which is of a different type. Two special scales were intended to be shown, but the engraver or draftsman fell down and only the Duluth & Iron Range scale for weighing ore is shown, and that twice.)

Length of Track Scales.

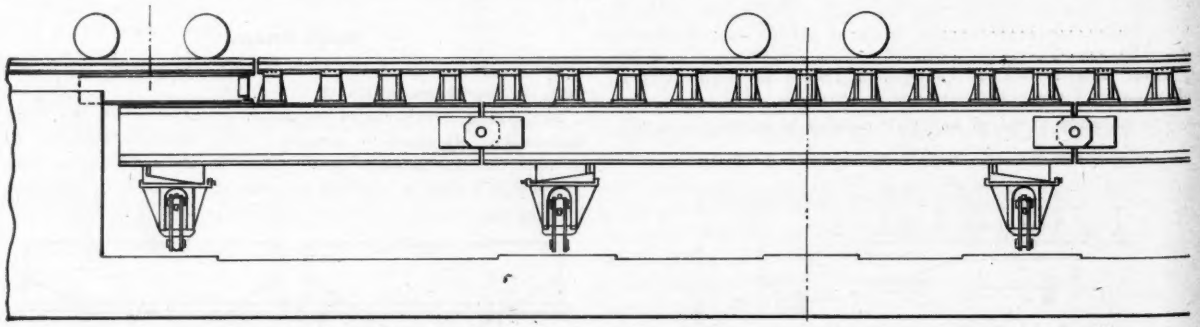
No hard and fast rule can be given for length of scale. The traffic of a road may be practically all confined to 36-ft. cars, with a wheel base four or five feet less. Another may have 40-ft. cars with 36-ft. wheel base. Some automobile cars are 50 ft. with a wheel base near 46 ft., while coal cars vary from 34 to 41 ft. with wheel bases four or five feet less. The American Railway Association recommends that the scales be long enough to weigh any cars offered, and preferably longer. It is probable that the average length of cars will increase. Answers to queries sent out by the committee show a diversity, 40 ft. being the shortest and 67 ft. the greatest length recommended, the latter being for gravity weighing.

The type of scale installed affects the length. If the type shown in Fig. 35 is followed, the scale iron will give a greater scale length than any other design.

Capacity of Scale.

The capacity of scales is a term over which there is great confusion. The average buyer supposes a 100 ton, a 150 ton, or a 200 ton scale to be capable of weighing correctly and without undue injury a load in the ordinary car up to those amounts. The Standard Scale Co.'s "Model Scale Specification" assumes each section to bear ¼ of the 150 tons in the scale of this rating. This gives a loading of 75,000 lbs. on each section, while reference to the table above shows that the superimposed load is over 100,000 lbs. for a car weighing only a little over half the rated capacity of this scale. Figure 50 illustrates the conditions from which the data in the above table was obtained, and this is a condition obtaining in all scales where spot weighing is done.

Mr. Bousfield of E. & T. Fairbanks & Co. advises that the B. & O. scale is figured for a distributed load (not a concen-



Sketch Showing Advantage of Hinged Girders. Note:- Absence of Upward Deflection at Ends.

Figure 42-B.

trated load) of 330,000 lbs., while the A. T. & S. F. scale is figured for a distributed load of 220,000 lbs. Figure 51 shows a 52 ft. scale with a distributed load. The two intermediate sections each receive ⅓ the load and the two end sections each receive ⅙. The A. T. & S. F scale with sections designed for 73,333 lbs. is subjected to loads as shown in the above table, the end section having a load of 117,500 lbs. and the intermediate sections a load of 89,500 lbs. The scale is not necessarily unsafe as a factor of safety is used, and the scale is supposed to be designed for 50% impact. This does indicate how near a load of ¾ the rated capacity comes to the maximum for which the bearings are designed.

The B. & O. scale, according to the above, is designed for 110,000 lbs. on the intermediate sections, and with impact, for the same on the end sections. Altering the figures in the table to fit this 52 ft. scale instead of the 46 ft. scale, we find the load as in column B to be 103,500 lbs., and as in column C to be 101,000 lbs. These two examples indicate how little the rating indicates the service capacity.

Dead Rails.

Are dead rails necessary? Formerly they were so considered, but since car wheel loads have increased to be much nearer engine wheel loads, the question is an open one. Formerly 5000 lbs. was a car wheel load, when 20 ton cars were in use.

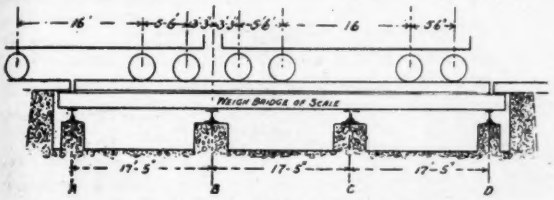


Fig. 50. Concentrated Weight on One Bearing.

Wheel loads on coal cars may now easily equal 18,750 lbs. each.

(Considerable information is given under this head, and it is certainly a matter not to be settled arbitrarily.)

Scale House.

In answer to our letters of inquiry we found that 56 advise the use of scale houses and 24 do not. Space, rather than locality, seems to be the governing factor; for safety the scale house should not be closer than 8 ft. from the center of track.

With a Streeter-Amet recorder, a scale house must be provided, and must be heated in cold weather. Where weighing is continuous most of the day, or where done in two or more intervals exceeding an hour each, a scale house is advisable. In some places a canopy will suffice, and is cooler and requires no artificial light.

Lighting.

Sufficient light should be provided in scale houses to enable the weighman to read the beam and the car initials and numbers. Lights should be located to prevent trainmen's shadows from obstructing the weighman's view of the beam or the car numbers.

(The above two subjects are worthy of a much fuller treatment. The scale house as often built is a clear waste. Often one sees the scale house standing open, windows opened to their limit in coldest weather because the design is such as to hamper the work of weighman by impeding his vision. Much more space could well have been given to this phase of the subject.

Scale appliances, the easer and flexible easer rail, the detector bar, and mechanical hump are described and some easily understood rules for hump scales are given. A very clear description of a recording device is given and the following showing limitations on its use is given.)

Easers, Easer Rails, Automatic Recorders, Etc.

W. A. Clark, chief engineer of the D. & I. R. Ry., submitted the following information regarding use of the Streeter-Amet machine. The ore cars weighed frequently have a gross weight of 150,000 to 160,000 lbs., loaded, are 24 ft. long between centers of couplers, have 18 ft. 6 in. to 19 ft. 8 in. car wheel base, and 5 ft. to 5 ft. 7 in. truck wheel base. The ore scales are on a track with about 0.06% grade, and the tracks are used practically exclusively for ore trains. The track is kept in good condition, with uniform grade, so that the motion over the scales will be nearly constant, with a slight tension in the draw bars. The locomotives must run over the live rail, to prevent delay, but they move carefully and we do not find that they do any damage. The Streeter-Amet recorder is used and recommended. In a test, 53 cars weighing close to 150,000 lbs. each were weighed in the train by the recorder and later spotted and weighed by hand; 21 cars checked exactly, 22 weighed light an average of 180 lbs., and 10 weighed heavy an average of 210 lbs. The total weight was over 7,500,000 lbs., and the difference in the weights by the two methods was only 1800 lbs.

H. L. Dresser, chief engineer of the D. M. & N. Ry., submitted the following information: Our ore cars are 24 ft. long and are weighed on two scales with separate scale tracks. The tracks are level for 300 ft. of the approach and about a train length beyond scales. Back of the approach the grade is 0.2%. These scales are checked every morning and the Streeter-Amet recorder weight has been checked by hand weights, and there has been no appreciable difference. Trains must be handled at a uniform rate, however. The scales have no dead rails. Trains

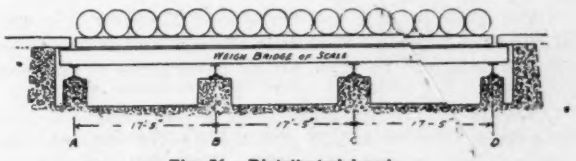


Fig. 51. Distributed Load.

pass over at the rate of about two miles per hour, the weight of the car being on the scale rails about five seconds before the trip starts the recording machine.

A. R. Raymer, P. & L. E. R. R., submitted the following information: One scale we have installed at Glassport has been in service for 4½ years, weighed 1,000,000 cars, with a maintenance expense of not over $20.00. We can check up the Streeter-Amet recorder at any time by spot weights and get the same results. During the 4½ years it has not been necessary to adjust the scale once, and the variation has never exceeded 20 lbs. on any section. I am convinced accurate results can be obtained by weighing devices, provided the scale is designed of sufficient strength, is properly braced, with approach rails designed so that cars pass on and off the scale without causing vibration in the beam. Weights taken with cars vibrating vertically will not be accurate. The recording machine is provided with a device which prevents inaccurate weights from being recorded on account of cars conflicting below or above; in that case no weight will be recorded. If these conditions are satisfied, the automatic recorder is preferable; it eliminates human errors and cars can be handled at four or five miles per hour as against 1½ to two miles per hour by hand. If there is any uncertainty about the weight of a car weighed by hand, the weight is more liable to be guessed at than to have the car brought back for reweighing.

Weighing cars by drifting is used on tracks with light grades. The car is cut loose from a slowly moving train and drifts guessed at than to have the car brought back for reweighing.
car riders.

L. L. Sparrow, Engineer of Roadway A. C. L. Ry., submitted the following information: We weigh cars of phosphate rock on scales by cutting the car loose and letting it roll away from the train. The scale and 30 ft. of track each side is level. Beyond the scale the grade is 0.3%, descending for 650 ft., to move the cars to one of three tracks. This grade is not sufficient for a cold climate, but is in our climate with equipment

in good condition, unless there is a high wind against the movement. We had a 0.3% ascending grade to the scale, but changed it to 0.6% part of the way and a slight down grade the rest of the way. This is the best arrangement we could make at that point on account of conditions. If conditions make it possible, I would advocate a descending grade of about 0.6% to a point 40 ft. above the scales, level across and about 40 ft. beyond scales, and then a descending grade of about 0.6%.

Type Registering Devices.

(The following about the type registering device is the only one in print which gives the actual facts about it:)

The type registering device is different from the recorder above only in that the weight, as determined by the operator poising the beam, is printed on a card by manual operation of the poise lever. It assures accuracy in recording the exact weight at which the poise is adjusted, but does not assure that the weighman will bring the beam to a true balance, that he will not use his free hand to bring the beam quickly to rest, or that a portion of another car is not included on the scale rails when weight is recorded. It does guard against errors in reading the beam or transcribing the weight. It is a device within the sliding poise which always presents at a fixed spot the figures shown on the beam on that spot. This device is made with small differences by practically all the scale companies.

Scale Beams.

(The following about scale beams shows the error into which a committee may fall. Practically all large capacity beams are of cast iron, and no other known metal gives equally good results.)

Opinions of correspondents favor a steel beam, as it is thought no other metal will give the required stability. One correspondent suggested a cast iron beam with a graduated steel bar dowelled in. The beam should be so rigid that under working load applied with a testing machine the deflection of the tip from the line of the pivots will not exceed 1/10 in.

A double beam is preferred for hand work by the weighman. The tare is set off on the upper, and the net weight is then obtained from the lower beam. A special beam is necessary for a type registering attachment.

Where a Streeter-Amet recorder is used, best results are obtained with a multiplication not over 400; for hand weighing, 800 is common.

Locating Scales.

In locating scales, consideration should be given to type of scale and pit, whether overhang is to be used, and how much, whether a dead rail is to be used, and whether a pocket track is to be provided. Consultation with the yardmaster or other interested officials will probably develop many conditions which influence the location. Prominent factors to be considered in the location are: convenience in switching, facilities for handling cars between the scale and the yard tracks, track connections, gradients, alignment, track spacing, drainage of scale pit, length of scale tracks, etc.

Scale tracks should be of sufficient length but not wasteful of storage space and the scale should be located so that trains will not block highways. The engineering department should draw up profiles and plans for the location, giving special consideration to drainage, and, if necessary, obtaining foundation data by a test pit to note the soil formation. If drained by tile, the upper end should be at least 6 in. below the scale pit. If proper drainage cannot be provided, the scale pit should be made waterproof, with a sump and pump for removing water.

The St. Louis & San Francisco R.R. makes the following assumptions of loads for a 50 ft., 150 ton track scale:

Load on side wall next to scale house, 3½ tons per lin. ft.

Load on side wall apposite scale house, 2 tons per lin. ft.

Load on two end piers supporting lever stand, 76 tons each.

Load on two center piers, supporting lever stand, 102 tons each.

Load on two end walls of pit, supporting ends of scale rails on approaches, 30 tons each.

This road also uses the following as safe loads for different materials:

	Tons per sq. ft.
Rock, the hardest, in thin layers, in native bed	200
Rock, equal to ashlar masonry	25 to 30
Rock, equal to the best brick masonry	15 to 20
Rock, equal to poor brick	5 to 10
Clay, in thick beds, always dry	6 to 8
Clay, in thick beds, moderately dry	4 to 6
Clay, in thick beds, but soft	1 to 2
Gravel and coarse sand, well cemented	8 to 10
Sand, dry and compact, well cemented	4 to 6
Sand, clean and dry	2 to 4
Quicksand and alluvial soils, etc	½ to 1

Sufficient room should be provided for a scale house to give correct clearance, and scale track would well be located a foot above adjacent tracks as the latter are quite likely to be raised. Live rails and the track for at least a car length in each direction should be tangent. It is desirable to provide track rails as long as the platform for live rails, and two feet longer for dead rails, to avoid joints on scale.

Material should all be on the ground before work commences, and the work should be done by the engineering department.

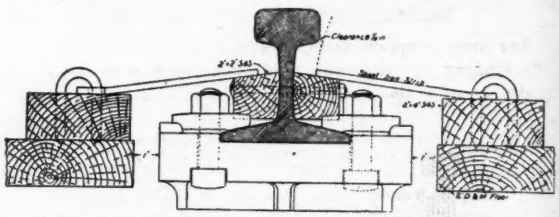


Fig. 66. Rail Shield Conforming to Minnesota State Specifications.

The drain tile should be laid before excavating the pit and the excavation should be fully protected by fence and lights. The upper foot of anchor rods, if their lengths permit, should be enclosed in a boiler tube of diameter to give some play, to take care of inequalities in the castings. Concrete walls and piers should be allowed 10 days to set, and castings should be set with a level. The scale installation should be in charge of an experienced man, a representative of the scale company, provided an acceptance test is required.

Rules of the Minnesota R.R. and Warehouse Commission.

(The report then gives the specifications of the Minnesota Railroad and Warehouse Commission for installing scales.)

Figure 66 shows the rain shield required by these specifications, and figure 67 shows one adopted by the P. & L. E. R.R. and the B. & O. R.R. Figure 68 is proposed by Col. A. S. Dodge of the Western Weighing Association. Figure 67 is better than Figure 68, but is less effective than Figure 66 as a rain shield; it is, however, less apt to become obstructed.

The weigh bridge is usually designed for the heaviest concentrated load to which it will be subjected—the arrangement in Figure 39 with the heaviest axle load likely to come on the scale may be used. The I-beams or box girders which sustain the deck should be computed for the live load of the heaviest locomotive used, probably the same loading as for bridges.

Ventilation.

The scale can be ventilated by a shaft or any method which will not allow the wind to blow directly on the scale parts. The pit is preferably heated by steam coils, but may be heated by a stove placed in an excavation to heat both scale house and pit. The deck should be as watertight as possible. Most decks are of planks 2 to 6 in. thick, and with thick planks they should be grooved on both sides, the tongue being a separate piece. There are two installations with steel decks and we have heard of reinforced concrete floors.

The installation of a scale is of special importance. No scale, however well designed and built, will give correct weights if improperly installed.

Maintenance.

Mr. Romig submitted the following information on timber girders: It is hard to secure timbers that have not been bled and wind shaken and one such timber spoils the accuracy of the scale. Timbers vary in hardness and the irons sink into them non-uniformly, throwing the scale of of alinement, and a scale in this condition will weigh accurately only within a very narrow range. Platform timbers spring down very perceptibly between scale sections as heavy cars pass over, and this springing causes various errors due to the dullness and direction of wear of the knife edges.

Some of the most common troubles which cause a scale to weigh inaccurately are named below:

(1) Troubles due to carelessness of weighmaster: Improper balance; scale out of balance; another car partly on scale. (2) Troubles due to weakness of scale: Deflection of scale bridge; deflection of levers. (3) General troubles: Deck binding; rails binding; broken castings; broken bearings; dull bearings; bearing feet resting on angle irons; insufficient clearance between bearing feet and scale timbers; levers out of line; fifth lever out of line; main lever loose; foreign matter in friction with levers or scale parts.

Remedies for Scale Defects and Ailments.

The more common scale defects are: (1) Binding of deck; (2) binding of rails; (3) binding between yoke and bearing plates or scale timbers; (4) bearing feet or plates resting on or coming in contact with angle irons on frames; (5) levers getting out of line and level; (6) dull bearings and broken castings.

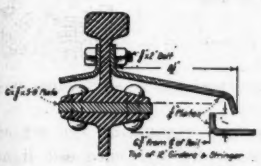


Fig. 67.

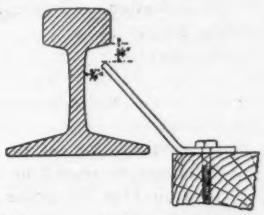


Fig. 68. Another Rain Shield.

To prevent trouble from (1) above, the scale platform should be cut to give a minimum clearance of ½ in. around edge and pedestals. All openings should be beveled on under side to prevent anything wedging into them. Coping timbers should be anchored to foundation walls, and dead rails laid outside of coping should, if necessary, be anchored by rods set against posts driven outside the coping. Platform checks should be adjusted to allow ⅛ to ¼ in. swing. If necessary, to hold the platform in proper place, anchor rods should be anchored to the foundation walls and attached to the platform girders or stringers, ends of anchor rods next to wall to be slightly lower than the other ends.

To prevent trouble from binding of rails (2), platform rails should be anchored to stringers or girders, by bolts passing through rail base. Track should be anchored on approaches. Probably the best method is to use a pair of switch points near the scale, and adjust at that point for expansion and contraction. Space at joints between scale and adjacent rails should not exceed ½ in.

Defect (3) can be prevented by giving proper clearance at installation between yoke and platform timbers and by tying timbers securely at top and bottom to prevent spreading. Binding of these parts due to uneven foundation, causing platform to swing to one side, can only be remedied by leveling up the stands.

A remedy for (4) is to drop front or inside edge of plates into the girders or stringers, about ¼ or ½ in. Where soft wood is used in stringers, it is often desirable to fit hardwood or steel plates under the bearing feet or plates. The greater the bearing surface, the less the crusihng.

Levers get out of line or level (5) by foundation failures, and should be remedied by renewing and not by the use of shims which is temporary only. An exception to this is the use of steel plates in a steel constructed scale. Five or more section scales with a 1 to 1 transmission frequently get out of order due to transmission or connecting levers being out of line or level on account of poor anchorage. Great care in the installation and in inspection and maintenance is necessary to overcome this trouble. The fifth lever does not get out of line or level except on account of very bad condition of its supporting timbers. If the fulcrum stand is securely anchored, the fifth lever can be levelled by adjusting the turnbuckle in the steelyard rod.

Dull bearings and broken castings (6) are due to wear and corrosion. The pivots in the levers for the end sections show the most wear, due to the impact they receive. A buffer or easer rail will remedy this trouble. A liquid or oil on the bearings tends to collect dirt, which is probably as injurious as corrosion. Scale castings are broken, due to heavier loads being imposed than they were designed for. Scales should therefore be provided with dead rails, and all locomotives with greater wheel loads than the actual capacity of the scale should not be allowed to pass over scales. The practice of adjusting nose irons to overcome irregularities in the weights is to be condemned, and such adjustment made only when it is certain other influences are not present. The committee recommends that the use of timber be discontinued except in platforms. Even with concrete and steel, however, to have accurate scales, the parts should be made amply strong so that there will be no appreciable spring or deflection in the weigh bridge or in the levers, and knife edges and pivots must be of sufficient size for the loads imposed.

Inspection and Testing.

A scale may be in bad shape, and the scale inspector will adjust it to weigh the test car correctly, but the scale may not then be in condition to weigh a load of, say, three times the weight. The inspection is not to determine whether the scale is strong enough for the purpose, but to put the scale in condition to give the best possible service. For best results, the scale mechanism should be inspected daily by the weighman, and probably at least once a month by an expert, and it might be well to test it at the same time. Some companies with good installations have found it advisable to put the test car on daily, while the excellent installation on the P. & L. E. R. R. might have gone five years without other inspection and test, judging from the results of tests.

(The report calls attention to the fact that 57 roads, having over a million and a half freight cars, make a practice of testing their scales, while 28 roads having 175,000 freight cars have no stated practice for testing, although they have theirs tested to some extent by connecting roads.)

Tests of scales are of three types: (1) Daily tests by weighman to see that neither platform, scale rails, or parts in the pit are binding, or their operation being interfered with; weekly tests of balance with car of known weight loaded with material which does not change weight by absorbing moisture, as does coal; test of sensitiveness of both beam and platform should be made at this time. (2) The beam test can be made by poising the balance, then moving it down to a balance from a higher weight, then moving it up to a balance from lower weight, to see if results agree. (3) The platform test is made by adding weight to platform after beam is poised with car on it. A man stepping on the scale rail should suffice, and scale should show this change with reasonable accuracy.

Tests should be covered by accurate daily reports by the weighman, covering fully the features inspected and tested. The monthly or bi-monthly visit of the scaleman or scale carpenter should be covered by a more elaborate report noting the

condition of pit, mechanism, platform, rails and approach, whether weighing rules are being observed, and work done on the scale. The report of the inspector with the test car should cover all the above conditions and others fully, besides giving in detail the results of each test with test car, giving the true weight of car and the weight recorded on each section at each test.

Adjusting.

A complete method of adjusting is given, with a diagram, as developed by E. Motchman. This method is too extensive to outline here. Copies of the original report may be obtained by addressing RAILWAY ENGINEERING.

The Scale Department.

There are excellent reasons for intrusting scales to the accounting rather than the engineering or maintenance departments. Scales should be designed and installed by the engineering department with a supervisor of scales who is preferably a mechanical or bridge engineer. The collection of charges is in the hands of the accounting department, which would be naturally desirous that the scale be accurate, while the maintenance department might be more liable to figure on keeping the structure merely safe, as compared with other structures. The danger is that a minor accounting official may overrule the scale supervisor. But if the latter was capable and his sanction necessary for appointments or dismissals of weighmen, the chances for good work from this department would be greatly increased.

The Scale Shop.

A road with 12 to 30 track scales and the complement of other scales should have a shop 20x24 ft., with a concrete sealing platform 4x6 ft. The floor is preferably of concrete, all except the sealing platform to be covered with flooring. The building is preferably of brick or concrete. It should have a forge and anvil, lathe, drill press, power-driven emery grinder, bench and bench tools, set of weights and a complete apparatus for sealing scale levers.

A road having from 30 to 50 track scales should have a building about 30x50 ft., equipped with a lathe, planer, reamer, two drill presses, emery wheels, bench and bench tools, forge and anvil and tools, an elevated track for one man to handle any of the levers, slotting machine, straight edges and gages, a master even balance beam for testing test weights, set of standard weights, a master scale for testing test cars and minor tools.

For a similar road, which would also build its own scales, is recommended a building about 40x80 ft., of brick or concrete, with a floor of wood except a concrete floor for sealing purposes. It should have a lathe, planer, shaper, two drill presses, two emery wheels, and complete sealing device for sealing all levers, also a complete set of weights for sealing purposes, from 1/64 oz. up to 5 lb., and one each 6 lb., 10 lb. and 50 lb. sealed weight. There should be a forge 3 or 4 ft. diameter, sufficient reamers for reaming out all kinds of loops, a buffer for polishing beams and sufficient bench and bench tools. There should be also a master scale and equipment. This last is in view of the purchase of all castings (as the roads so largely buy other castings) and the purchase of the beams.

Should Railways Buy or Build Track Scales?

Answering queries sent them, the following information was collected:

Of the eight roads which build their own scales, every one continues in favor of so doing. This seems a vital point. Of those who investigate only, four are opposed to building and five favor building. Of the eight having practical experience, all favor building the scales.

All who do build their own scales believe they get a better scale and get it at less cost. In this relation the committee has encountered one significant item. No less than eight representatives of one of the older scale companies have told the chairman that some railroad was now buying scales when it had formerly built them, and in but one of these cases was there any truth in the report. In that one case it was found upon investigation that a road which for many years has been building its own scales with platforms 40 ft. long had bought from the scale company one scale having a 52 ft. platform.

Answering the objection that a large force of skilled men would be required for building the scales, it may be said that one road of 4,800 miles, with 65,000 freight cars and 116 track scales, has built its own scales for many years and is able to take care of repairs and renewals with a shop force of four men (a machinist, blacksmith and two helpers). Four outside men also work in the shop a part of the time.

Acceptance.

Under this heading the following information, submitted by Eugene Motchman of the Standard Scale Co., is pertinent:

"If the committee establishes the maximum operative capacity at 100 tons, the scale may be designed for 150 or 200 tons to meet long service and safety, yet the test of accuracy need not exceed the amount railroad companies handle, and upon this consideration a 50,000 lb. test car meets the present requirements fully. To test a traffic scale upon its nominal capacity of 150 or 200 tons can better be done by the engineer who is familiar with calculations on fiber stresses than by the inspector who travels with the test car, unless he is provided with a schedule giving the dimensions of the girders and levers for the corresponding spans and weights acting at certain points to check them up.

"It is true that all adjustments made under a greater pressure proportionately reduce minor deficiencies of the always present deflection, and thereby include as corrected all intermediate weights from zero to the amount of the test car per section, and if the limit of freight cars does not exceed 200,000 lbs. no section will be taxed harder than by the test car. To test the scale by separate test weights of 50 or 100 lbs. each, to any intermediate amount from zero to 50,000 lbs., would be a waste of time. It would only establish the spacing of the notches upon the weigh beam and this can better be done with a pair of dividers or inspection of scales during erection, to which any purchaser is invited.

"The committee may safely recommend a test with two 50,000 lb. cars upon 8 ft. wheelbase in cases where extreme accuracy is required, approaching thereby the conditions existing in actual service and removing in this manner all skeptical doubts. Experience has shown that a test car in total can be kept a standard weight upon a master scale without great expense; a collection of 1,000 pieces of test weights become in a short time a doubtful mass when lugged from one end of the line to the other. Some test weights should be carried upon a test car to cover the indication of the front beam, which is 1,000 or 2,000 lbs.; also one 10 lb. and two 20 lb. weights, to determine the sensitiveness of the platform."

Conclusions.

Some of the pertinent things in the data submitted by the roads reporting to the committee are the following:

Fourteen railroads reported buying scales to plans or specifications or both or building in their own shops. These roads have 736,000 freight cars. Eighty-five railroads, having 1,375,000 freight cars, report they buy some makers' design or any maker's scale. In other words, nearly two-thirds of the traffic of the country appears to be weighed on scales which are not built to any standard requirement.

(One of the greatest oversights of this report is the ignoring the matter of waterproofing a scale pit. This is barely mentioned. It is a thing which can be done, for swimming tanks of large size as well as fountains are built. One wonders why bridge and building men overlooked this. It would be worth while to discuss the building of an inverted roof from some of the built-up systems of roofing; making it three or four times as thick as a roof is made would serve in this connection.)

CONCRETE DEPARTMENT

Clamps for Splicing Reinforcing Bars

THE idea still seems to be prevalent in some localities that satisfactory splices of reinforcing bars in tension can be made by the use of clamps, thereby reducing the amount of lap (excess material) required to a minimum, in spite of the fact that tests have shown that such splices are not capable of properly developing the bars, no matter what the style of clamp. The only way to develop the strength of reinforcing bars is to lap them a sufficient distance so that the stress may be transferred from one to the other by bond, for beam tests show that the slip of reinforcing bars in tension marks the beginning of the beam failure.

Tests on bars spliced with clamps of various types show that an amount of slip sufficient to destroy the bond between concrete and steel takes place in practically all cases before the clamps come into action and their purpose is therefore defeated.

In many cases where long bars are required and splicing must be resorted to, it is advantageous to clamp the ends of bars to be spliced in order to facilitate holding them in position. When this is done the bars should be lapped a sufficient distance to develop their strength in bond, no reliance being placed on the clamps to transfer stress. The bars should also be separated at least two diameters center to center at the splices in order to allow the concrete to completely envelop the bars, otherwise the bond will be insufficient.

Experience and tests have shown that a sufficient length of splice of bars in concrete is the only really satisfactory way of transferring stresses, both tension and compression, in bars, and that the use of clamps tends to give a feeling of false security, which is sure to lead to disaster if too much economy is practiced in the amount of lap of steel at splices. It should be remembered that a small additional amount of steel in the shape of bars at the splices is better than "any clamp" for developing the strength of bars in reinforced concrete.

Saturation of Concrete

THE abstract of a paper by Mr. J. L. Van Ornum, on "The Effect of Saturation on the Strength of Concrete," appearing elsewhere in this issue, contains information of the greatest value to the railroad engineer. Briefly stated, the tests indicate that the occasional saturation of a concrete decreases its strength temporarily to about 65 per cent of its strength when dry. In building work the strength of the concrete can be preserved by continual wetting until the building is enclosed, as suggested by Mr. Van Ornum, but all parts of concrete railroad bridges and similar structures are not subject to such treatment, since they cannot be readily protected from saturation by rain.

The remedies which suggest themselves are: (1) the waterproofing of the structure so that water and moisture cannot penetrate into the concrete, or (2) by the selection of low unit stresses to provide for the reduction in strength due to saturation, or (3) a combination of waterproofing for some parts and lower unit stresses in exposed members.

Ordinarily, the unit stresses used in the design of railroad structures are relatively low, and a reduction in strength of the structure by saturation will be of no consequence, since the factor of safety covers such decreases amply if the concrete is of good character. However, as Mr. Van Ornum states, it is the combination of poor materials, poor workmanship, poor design, and reliance on the factor of safety, together with saturation, which may cause failure. It therefore behooves the engineer to take due account of the lower strength of occasionally saturated concrete when designing structures, since its neglect has no doubt been the indirect cause of several failures of concrete structures.

WORLD'S LARGEST ORE-SHIPPING DOCK.

The Duluth, Missabe and Northern Railway Co.'s new concrete and steel ore dock at Duluth, Minn., has a capacity of 112,000 tons of ore and is the largest in the world. The concrete deck for the steel superstructure carrying the bins is 2,416 ft. long, 64 ft. wide, and contains 24,000 cubic yards of concrete. The concrete deck is 4 ft. 6 in. thick on the inside and 7 ft. 6 in. thick on the outside face, the concrete being supported on 14,600 wood piles from 50 to 60 ft. long. Between the outer rows of piles, U. S. steel sheet piling, 40 ft. long, was driven all around the dock, held together at the top by steel rods so as to retain the sand fill.

The steel superstructure is carried on concrete piers 5 ft. square on top, with battered sides, resting on the concrete deck. Above the steel bins are two tracks which permit dumping ore directly into bins from trains.

The concreting plant, consisting of elevated sand and stone bins, a mixer and a 50 ft. tower with distributing spouts, supported by a boom, was mounted on trucks with a gauge of 23 ft. This plant weighed 120 tons. The track was carried on 8 in. x 12 in. x 26 ft. ties, resting on piles. Expansion joints were placed every 144 ft. in the deck, and the concrete between was poured in four sections, each 36 ft. long. The tonnage of reinforcing steel used was 200 tons, while 32,000 yards of sand, stone and gravel and 27,000 barrels of Universal cement were used.

ROSE STREET VIADUCT, NORTH LACROSSE, WIS.

The new Rose Street Viaduct over the main tracks of the C., M. & St. P. Ry. at North LaCrosse, Wis., is to replace an old timber structure which was built in 1883.

The viaduct will be about 1,100 ft. in length, consisting of 850 ft. of concrete retaining walls, with earth fill; 100 ft. of reinforced concrete trestle, and a 140 ft. skew truss span with center truss. The truss span will have two 16½ ft. roadways; two 9½ ft. sidewalks, and will be supported on reinforced concrete piers. The approaches will have a clear width of 36 ft., with no sidewalks. Stairways at each end of the truss span affords a means for the pedestrians to cross the viaduct. The structure is designed to carry two lines of street car traffic. The amount of structural steel required will be about 210 tons, and the volume of mass and reinforced concrete will be about 2,400 cu. yds.

The estimated cost of the structure is $84,000, to be paid jointly by the City of LaCrosse, the Wisconsin Railway, Light & Power Company and the Chicago, Milwaukee & St. Paul Railway. The contract for the steelwork has been awarded to the Chicago Bridge & Iron Works. The construction work will be done by the C., M. & St. P. Ry. with their own forces, and will be hurried to completion as rapidly as possible.

A REINFORCED CONCRETE SUBSTRUCTURE FOR WOODEN WATER TANK. B. R. & P. RY.

Description of a Tower for a 50,000-Gallon Wood Tank, Which Has Been Adopted as Standard by this Road.—A Fireproof Substructure Combining Strength and Beauty.

By A. M. Wolf, C. E.

General.

On account of the danger of rapid decay and its susceptibility to fire, timber is by no means the most satisfactory material to use for the substructures or towers of wooden water tanks for railroad service. A great many tanks however, have been built in this manner and in addition to being unsightly the substructures have not always been satisfactory. It is not strange then, that with the advent of the use of reinforced concrete it should be applied to such structures, and gain favor among railway engineers to such an extent as to be used as standard, by a number of roads. The following description is of interest inasmuch as the structure described represents good modern practice in the design of structures of this type. The tank tower described was recently built at Indiana Junction, Pa., on the Buffalo, Rochester and Pittsburgh Railway.

General Design.

The deck carrying the 16 ft. by 24 ft., 50,000-gallon wooden tank, consists of an open octagonal framework of reinforced concrete beams supported on twelve reinforced concrete columns about 17 ft. high, arranged in the form of a cross at a uniform spacing of 6 ft. 11 in. each way, and thoroughly braced and tied together by horizontal struts at mid-height and just above footings. The deck beams are connected to the columns with curved fillets which add considerable to the appearance of the structure as is shown in Figure 1.

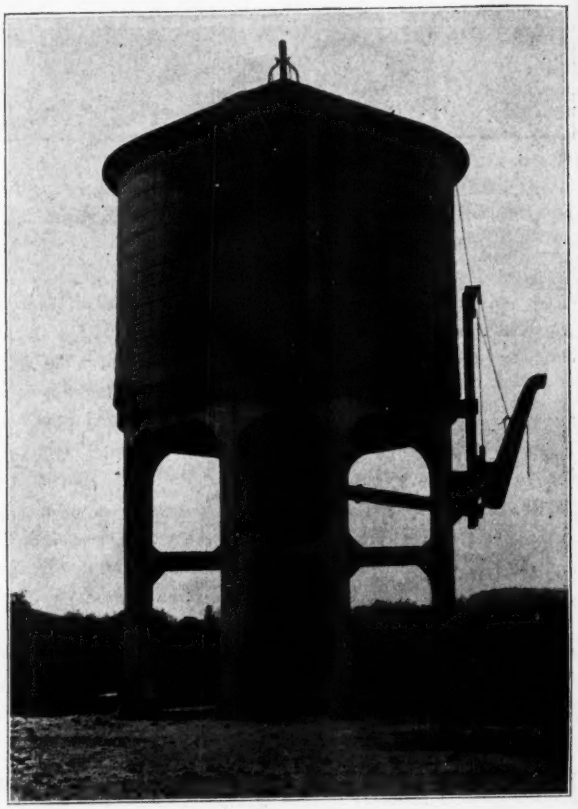


Fig. 1. Reinforced Concrete Substructure for Wooden Water Tank, B. R. & P. Ry.

Details of Design.

The footings twelve in number consist of a bottom course 4 ft. 4 in. square carried down to firm foundation, surmounted by a 5 ft. pyramidal plinth or pedestal 3 ft. 4 in. square at the bottom and 20 in. sq. at the top. The plinths are anchored to the footings by means of a 4 ft. rail at the center.. The four

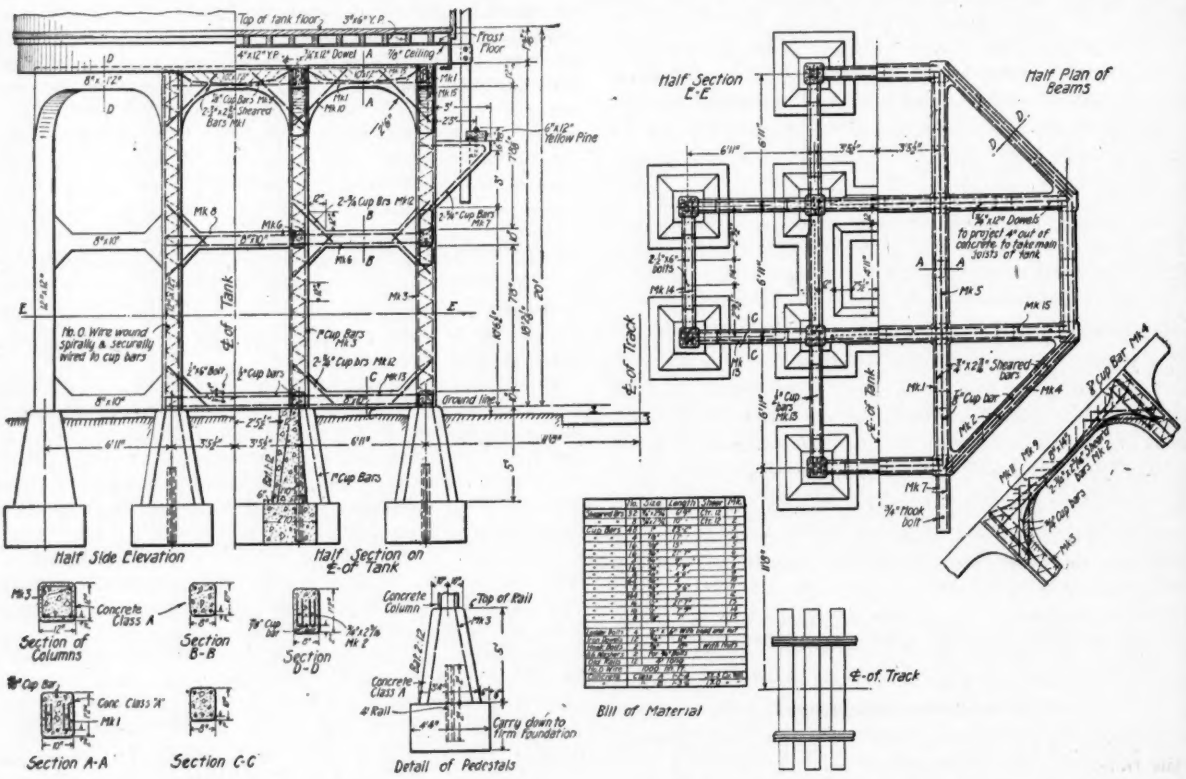


Fig. 2. Details of Reinforced Concrete Tower for Wooden Water Tank, B. R. & P. Ry.

interior footings are connected by crosswalls to form one footing with an open space at the center for pipes running up to tank. Class "B" concrete, a 1:3:6 mixture, was used in the footing course of pedestals and Class "A", 1:2:4 concrete in all other parts of the structure.

The columns are 12 in. square, reinforced vertically with four 1 in. cup bars wrapped with No. 0 wire wound spirally at 12 inch pitch and securely wired to the vertical bars. These bars are bent out at the bottom and carried down into the pedestals. Just above ground at the elevation of base of rail the columns are tied together in the form of five squares by means of 8 in. by 10 in. reinforced struts filleted at the top. The columns are braced at their middle points by a similar arrangement of horizontal struts connected to the columns with heavy fillets. By this system of bracing the unsupported length of the columns is greatly reduced and the structure made very rigid even with the small columns used. At a point 14 ft. above the top of rail two reinforced concrete brackets are placed on the columns next to the track to support the water spout. (See Fig. 1.)

The tank deck consists of an octagonal framework of beams connecting the outer columns, enclosing four lines of beams at right angles to each other connecting the corners of the octagon to the interior columns. The interior and the short exterior beams are 10 in. by 1 ft. 2 in. deep, reinforced with two ¾x2-3/16 sheared bars in bottom and in addition one ⅞ in. cup bar bent up into top of beam over supports, thus providing two bars, for negative moment stresses. They are connected to the columns with curved fillets of 2 ft. 6 in. radius, with two ¾ in. cup bars placed at 45° in the fillets.

The long diagonal beams connecting outside columns are 8 in. by 1 ft. 2 in. deep, reinforced in a similar manner as described above; the bent-up bars, however, instead of extending straight over the support are bent down again at right angles into the columns thus tying the columns together. These beams also have 2 ft. 6 in. radius fillets. The wood framing for tank rests directly on the concrete beams and is doweled thereto. The complete details of tower are shown in Figure 2.

All exposed edges of beams, struts and columns were rounded to a 2" radius and all concrete surfaces were rubbed down to a true surface with small briquettes composed of 1 part of cement and 2 parts of sand, with clean water, after completion. The unit stresses used in design were: Concrete in direct compression (columns), 500 lbs. per sq. in.; steel in tension, 16,000 lbs. per sq. in.; compression, 7,500 lbs. per sq. in. Bearing on soil, 3,000 lbs. per sq. ft.

The writer is indebted to Mr. E. F. Robinson, chief engineer, B. R. & P. Ry., for plans and photograph used in this article.

PROGRESS ON TUNKHANNOCK VIADUCT.

The Tunkhannock viaduct at Nicholson, Pa., on the D., L. & W. R. R., is now about 70 per cent completed. This bridge, consisting of ten 180 ft. arch spans and two 100 ft. abutment arches, with a total length of 2,375 ft. and a height of 242 ft. above the stream, will be the largest concrete railroad bridge in the world. The foundations for piers were carried to solid rock in open cofferdams of Lackawanna steel sheet piling, some of them 60 ft. deep. The arch ribs are being constructed on steel arch centering. Five sets of this steel centering will be built, each set being used twice. The concrete is distributed by means of a double tandem cableway extending over the site. This cableway was also used to erect the steel centering.

CONCRETE PRICES.

Very little change has taken place in prices of concrete materials from those given last month, and due to lack of space we are not repeating same.

THE EFFECT OF SATURATION ON THE STRENGTH OF CONCRETE.*

By J. L. Van Ornum.

*Abstract from paper read before the Engineers' Club of St. Louis, published in the April 1914 issue of the Journal of the Association of Engineering Societies.

The paucity of recorded information concerning the treatment of concrete specimens, with regard to moisture conditions during their storage while awaiting the test for strength, seems to indicate a general supposition that this feature has no considerable effect on results. The purpose of this paper is to invite attention; not only to the great importance of specifying and standardizing the moisture treatment of specimens intended for testing, but also to the further fact that similar conditions, as they act on the finished structures, will affect their strength considerably, and therefore should be considered in specifying the proper unit stresses. It is evident that this factor should not be ignored when great variations in strength, perhaps 50 per cent above or below a mean value, result from differences in moisture conditions.

This question has been the subject of investigation in the Washington University Testing Laboratory during the last six years and the writer believes the results thus far obtained to be so definite in their showing of a decided influence of moisture conditions on strength that he offers this summarized statement to the engineering profession.

The most important part of the investigation is that of the effect on the compressive strength of concrete produced by varying systematically the relative length of time of exposure in air and in water.

The test specimens were 8 in. diameter cylinders of 1:2:4 gravel concrete, mixed by hand to a moderately wet consistency. The cylinders were removed from the molds when 2 days old and were tested at the age of 6 weeks. The intervening 40 days constituted the period in which the duration of their immersion in water was varied systematically from nothing to full time. In Fig. 1 the average results of 240 tests are plotted. The ordinates give the relative strength based on 100 per cent for the specimens which were not immersed. The abscissas represent days in water after being removed from molds. From the curve it will be seen that specimens cured in air for 38 days and then immersed in water for 2 days, have a compres-

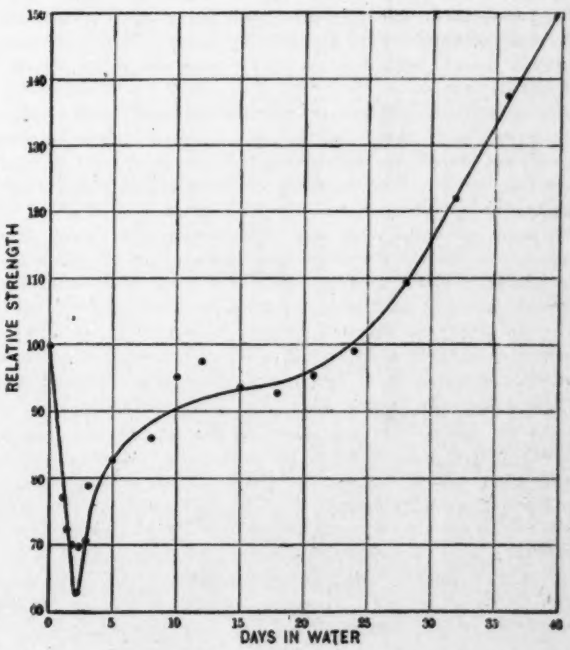


Fig. 1. Strength of Concrete after Immersion in Water.

sive strength of only 65 per cent of the air cured specimen. After 24 days immersion the strength is just about the same as the air cured specimens or 100 per cent. After this a practically straight line increase takes place and at 40 days the strength is 50 per cent more than for the air cured specimens.

It thus appears that the compressive strength of concrete exposed to air may be reduced nearly 40 per cent when saturated with water, but that this loss is actively regained as the treatment is continued. The word saturation is used advisedly because the minimum strength was found to coincide practically with the length of time required for the water to penetrate to the middle of the specimens. Very plainly, this loss of strength has no relation to the percentage of contained moisture, as it is not only regained but much exceeded if the saturation is continued long enough. Perhaps the reduction in strength is purely a temporary physical phenomenon which is gradually counteracted and finally dominated by continued saturation permitting the imperfectly developed chemical process of hardening to proceed actively. If this be true, concrete would regain something more than its original strength if dried out as soon as completely saturated, but this value would be less than that attainable by a continuance of the water treatment; also a repetition of soaking after such an experience would again temporarily reduce the strength but less than before.

In a series of experiments on the factors affecting the strength of bond between concrete and embedded steel, 74 tests were made to determine whether there existed the same tendency of rapid weakening at first and a following recovery of strength when the dry specimens were immersed in water. The results indicate clearly, for both plain and deformed bars, that the bond strength values, similarly, decline rapidly and then increase after saturation is complete as is the case with the compressive strength; although the average minimum observed was only about 75 per cent of that of the specimens cured entirely in air.

Thirty-two beams so constructed as to fail by excessive web tension in the concrete were tested at the age of 6 weeks, but the small number restricted the investigation to lengths of immersion designed to detect only the early loss of web tensile strength and its subsequent increasing value, without tracing it throughout successively lengthening periods of exposure to water to the limit of 40 days. The characteristic effect is again the same, the lowest average found being again practically ¾ of the strength of the air cured specimens. It may be that, in this case as with bond tests, the minimum value was not detected.

In a series of experiments on concrete prisms 7 years old to determine any change due to age in elastic properties, two specimens were immersed in water until saturated and then carefully tested. The resulting compressive modulus of elasticity for wet concrete was 66 per cent of that observed on the same specimens when dry. This lowering in value refers, again, only to the effect produced as soon as the saturation is complete; and has no reference to a continuance of the exposure to water, such as is reported on certain other tests at the University of Wisconsin where the figures given for the compressive modulus of elasticity of concrete specimens cured entirely in water for 26 days are about one-fourth greater than those cured only in air.

As the various strength values of dry concrete are temporarily reduced from 25 to 40 per cent by saturation, it would seem that this fact should be given definite consideration in fixing the working stresses used in the design of structures which may be thus exposed, or else conditions should be controlled in such a way as to prevent the weakening thus produced. No such effect occurs in concrete constantly under water or in moist earth from the time of its fabrication; but construction above ground, and therefore exposed to dry air for a time and then to a heavy rain or other source of rapid wetting, presents conditions under which this reduction of strength exists temporarily. Fortunately, the remedy is simple and inexpensive. It is to keep the exposed material thoroughly wet until its enclosure by exterior walls and roof renders its saturation by rain impossible. The case of parts not thus protected, or those for which enclosure is delayed is not so simple; because the length of time of saturation which will make the concrete safe against serious reduction of strength is uncertain. The systematic wetting of concrete is a well-known principle of good construction; but the writer's observation and experience suggests a very considerable tendency to regard that procedure as abstractly correct, but practically rather specious or trivial. One purpose of this paper is to present the facts in such a way that the frequent, thorough and faithful wetting of all parts of such concrete structures shall henceforth be no more ignored than is now the protection from freezing or disturbance while setting. Probably this treatment should be continued for a length of time substantially greater than that heretofore indicated—perhaps for a period expressed in weeks instead of days.

Undoubtedly, carelessness in a thorough control of this kind is a frequent contributing cause of weakness which is sometimes sufficient to cause failure. Very evidently, this temporary weakening of concrete by saturation is amply covered by the factor of safety required by good practice, if it be the only fault; but the materials may be considerably below standard, or the workmanship may be defective, or the design may encroach on the reserve of safety, or an occasional overload may be imposed; and if the material man, the construction superintendent, the designer, and the user of the structure should each rely on the others to fully meet the requirements, in the expectation that his own delinquency will be safely covered by the factor of safety, it would not require an impossible coincidence of such conditions to cause disaster; especially in view of the fact that considerable variations from the average strength values, which form the basis of design, necessarily exist in different parts of the structure. In fact, the failures which have occurred are generally a result of several such contributing causes. The writer believes that the considerable weakening produced by the saturation of dry concrete has invariably been a contributing factor in all those instances in which there was an active wetting of dry or partly dry concrete when subjected to essential stresses.

The fact that differences in control (which to the average artisan are seemingly unimportant) actually do exert a positive influence on its essential characteristics, constitutes a definite warning against entrusting it to the uncertainties of irresponsible or skeptical supervision, and assures ample reward for a competent control which is correctly adapted to develop its capabilities.

CONCRETE DISTRIBUTION SYSTEM, LUDLOW AVENUE VIADUCT, CINCINNATI, O.

Description of Gravity Spouting System of Unusual Dimensions.

By A. M. Wolf, C. E.

The gravity spouting system used for distributing concrete to various parts of the recently completed Ludlow Avenue Viaduct at Cincinnati, Ohio, no doubt ranks among the largest of such plants and is therefore of special interest to construction engineers.

The general conditions governing the design of the viaduct and the details of design of various parts of the structure were given in an article by the writer in the January, 1914, issue of Railway Engineering (page 11). It will be remembered that the viaduct proper is about 1,336 ft. long, 60 ft. wide and built entirely of reinforced concrete with the exception of a 110 ft. steel plate girder span over the railroad tracks, which is encased in concrete. The middle portion of the structure over Mill Creek consists of six solid barrel arches of 85 ft. clear span with a total length of about 600 ft. The approaches to the arch spans consist of transverse girders carried on rows of reinforced concrete columns, about 24 ft. centers, supporting longitudinal beams carrying the reinforced concrete slab deck.

The problem of economical distribution of concrete for such a long and comparatively low structure was solved by the use of long gravity chutes running from high hoisting towers to the points of deposition.

In Figure 1 is shown the spouting plant used in the construction of the arch piers. The tower built up of 6x6-in. posts securely braced both horizontally and diagonally, was 130 ft. high and placed near the pier of the south arch (left end in illustration). The total length of chute was 550 ft., made up of several sections all held to line and grade by drop lines suspended from a ¾-in. steel cable 900 ft. long extended from the main hoisting tower to a dead-man at the end of the line. The drop lines were provided with pulley blocks at each end so that the slope of the chute could be very readily adjusted in order that the concrete would flow to the best advantage.

The concrete was mixed in a No. 67 Ransome mixer of ¾-yd. capacity, placed at the foot of the tower. After mixing, the concrete was discharged into an Insley hoisting hopper and raised to the top of the tower by a hoisting engine. At the top, by means of a patented dumping device, the concrete was discharged into the spouting hopper, from whence its discharge into the spouting pipes was regulated by a laborer stationed at the top of tower, so as to obtain a continuous flow of concrete. The mixer was charged with wheelbarrows, the sand and stone being wheeled from storage piles nearby and the cement from a store house. In this manner an average of 480 sacks of cement was used in an eight-hour day.

In Figure 2 is shown the distributing plant used in concreting the arch superstructures and the north approach spans. The main tower at the mixer was the same one used in concreting the arch piers. In order to concrete the north approach a relay tower was placed near the last arch at the north end. The reason for using this method of relays for distribution was that all concrete materials could be most easily delivered to the site in cars at the south end of the arch portion of the viaduct, where the B. & O. S. W. R. R. tracks pass beneath the structure.

The concrete after being mixed on the south side of Mill Creek was relayed by spouting to the hoisting hopper at the bottom of the relay tower across the river at a distance of 440 ft. Then it was hoisted to the top of the relay tower 120 ft. high and chuted to a point 340 ft. away, making a total distance of 780 ft. from the mixer to the point of distribution. For the maximum day's (nine hours) output of concrete, 1470 sacks of cement were used and a force of 35 men employed. The entire amount of 18,500 cubic yards of concrete was deposited by gravity spouting plants, a few auxiliary plants besides those described having been used at the south end of the viaduct. The entire hoisting and spouting apparatus for the work was furnished by the Insley Mfg. Co., of Indianapolis, Ind., through their Cincinnati representative, Mr. C. T. Handman, to whom the writer is indebted for photographs and data on the distribution system.

It was first planned to use only one spouting tower and wheel the concrete from a reservoir at the end of the line into the desired location. The contractor, Mr. T. P. Strack, of Cincinnati, however, preferred to use the relay spouting system, and in spite of the long distance the concrete was spouted it was of excellent character and uniform mixture. The contractor's superintendent was Mr. Albert Witte, who had charge of the construction of the sixteen-story Ingalls Building at Cincinnati, the first and highest concrete skyscraper. The work was done under supervision of the city engineering department, Mr. H. M. Waite, chief engineer, and Mr. F. L. Raschig, engineer of structures.

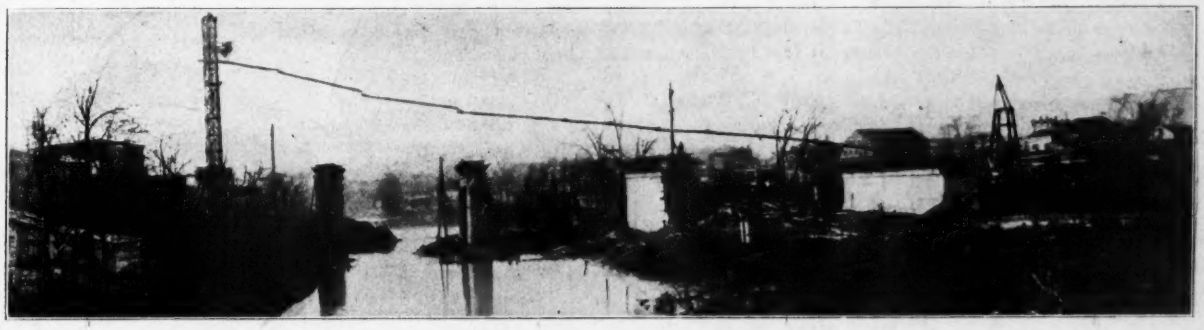


Fig. 1. Main Concrete Distribution Plant, Ludlow Ave. Viaduct, Cincinnati, Ohio.

The Seventh Avenue Bridge in Brooklyn, a steel structure encased in concrete, is being replaced by a new structure. In removing the old concrete, which was found to be of excellent character, it was necessary to drill holes in the same and insert small charges of dynamite, which shattered the concrete and allowed it to be pried and knocked loose by crowbars and sledges. The concrete was very dense and was so very effectively bonded to the steel that practically no rusting of the steel work was found.

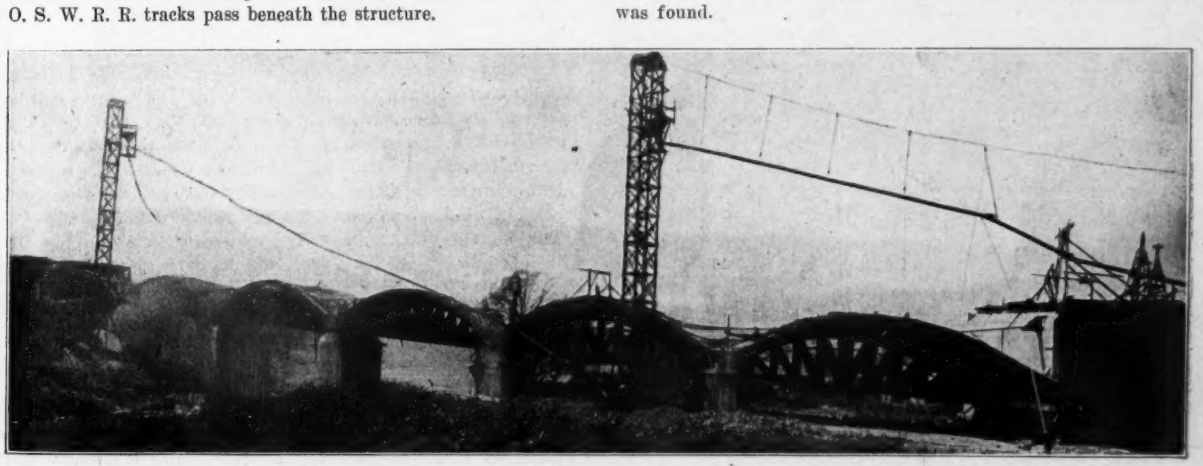


Fig. 2. Main & Relay Distributing Towers, Ludlow Ave. Viaduct, Cincinnati, Ohio.

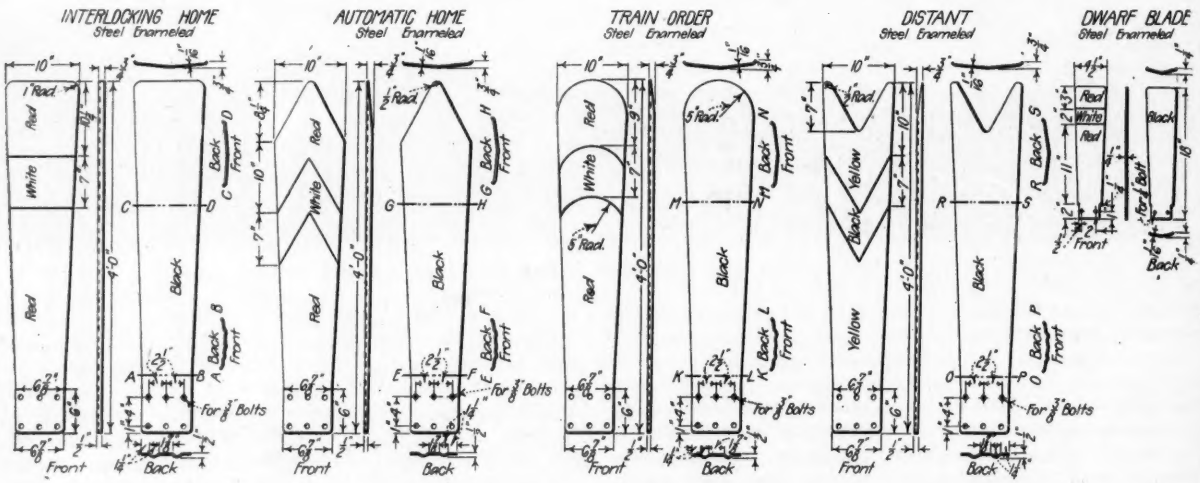
The Signal Department

AUTOMATIC BLOCK SIGNALS ON THE ITHACA BRANCH, L. V. R. R.

B. W. Meisel.

The installation of automatic block signals now under construction on the Ithaca branch of the Lehigh Valley R. R. when completed will protect that portion of the road lying between Van Etten Junction and Geneva Junction, N. Y. The signaling consists of 58.29 miles of single track and 1.2 miles of double track. The protection afforded is of the very latest type, known as "normal clear, absolute permissive block." With this system the road is assured of maximum capacity and safe operation.

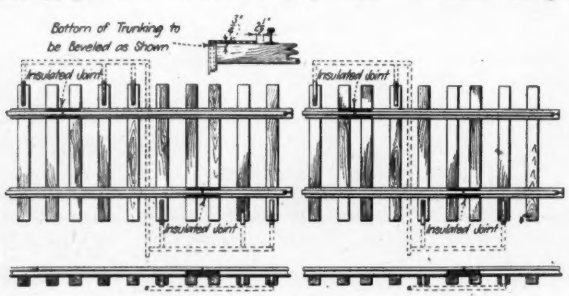
For opposing moves the protection is absolute, allowing only one train in the block, which is from station to station. For following moves the operation of the signals is exactly like that of double track, the block extending from signal to signal in the same direction.



Standard Signal Blades, L. V. R. R.

The signals used are upper quadrant, three position, operating from 0° to 45° to 90°. With the exception of one or two cases, the signal mechanisms are located at the bottom of the posts. The day indication is displayed by means of a semaphore blade made of steel, enameled in accordance with the standard colors. The blade is four feet long, pointed at the outer end. A plan of this blade, known as "the automatic home," is shown herewith, together with other standard semaphore blades used by the Lehigh Valley. The night indication is green for clear, yellow for caution, red for stop. The spectacle casting, which provides the means for displaying the night indication, is the Railway Signal Association type.

The signal operating battery consists of 400 ampere hour soda battery, placed in concrete battery wells of standard design.



Signal Location Cut Sections L. V. R. R.

The track battery for operating track relays consists of gravity, two cells in parallel per section, housed in seven-foot cast-iron chutes. The average length of a track section is about 3,000'.

Track relays are 4 and 16 ohms resistance, wall type, placed in iron relay boxes. Switch indicators of the semaphore type operating to 45° are used in all cases.

A sketch of the trunking layouts used at signal locations and cut sections is shown herewith to illustrate the difference between the two layouts. At signal locations there is one more bootleg required than at cut sections. The extra set of bootlegs is used where shunt relays are required. The object is to provide a separate set of bootleg wires for track battery and shunt relay.

The different sizes of wire used are as follows: For bootlegs, leads from track leads from track battery and in chutes, No. 12 B. & S. rubber-covered copper wire; leads from battery to signal motor, No. 8 B. & S. rubber-covered; leads from line to apparatus, No. 14 B. & S. rubber-covered. Line wire is all No. 10 B. & S. D. B. W. P. All lightning arresters are of the vacuum type.

The above installation of signals was installed by the General Railway Signal Co.'s forces under contract.

We are indebted to H. W. Lewis, signal engineer of the Lehigh Valley, for plans and information from which this article was prepared.

About one hundred cars in the one and one-half story building of the INTERNATIONAL CAR CO., Forty-second and Loomis streets, Chicago, were severely damaged by a fire Monday night. The frame building was completely destroyed. The total loss is estimated at $90,000.

THE NATIONAL TUBE CO. has moved its Chicago office from 1397 McCormick Building to room 1114, 288 South La Salle street.

THE WATROUS CO., Chicago, Ill., has moved its office from the Fisher Building to rooms 1101-2 The New Lytton Building, 14 East Jackson boulevard.

A number of the employees of the WESTINGHOUSE ELECTRIC & MANUFACTURING CO. and the WESTINGHOUSE MACHINE CO. went on a strike last week, because the management refused to recognize the demands made by the newly formed labor union, the Allegheny Congenial Industrial Union, and as a result the works of these companies at East Pittsburgh are partly shut down. The management of the company does not believe that the trouble will be of long duration.

TOWER "A" INTERLOCKING, PANAMA R. R.

The new interlocking at Cristobal Tower "A," Panama R. R., consists of an improved Saxby and Farmer mechanical interlocking machine with 35 working levers and one spare lever in a 36 lever frame.

The revision to the old plant was necessary on account of additional switches and the protection of all conflicting points by derails and additional signals. The track layout herewith shows the revised plant. All derails are of the Hayes type.

Fourteen levers control 14 signals, 12 of which are mechanical and 2 power. The mechanical signals are model No. 1, manufactured by the Union Switch & Signal Co., operating in the upper quadrant.

The power signals are upper quadrant, three position, operating from 0° to 45° to 90°. Both power signals are U. S. & S. Co.'s model. One is a style "B" (bottom post), the other is style "T" (top post), and each operates as a semi-automatic non-stick signal. The operating battery for each power signal consists of 16 cells 400 A. H.-B. S. Co.

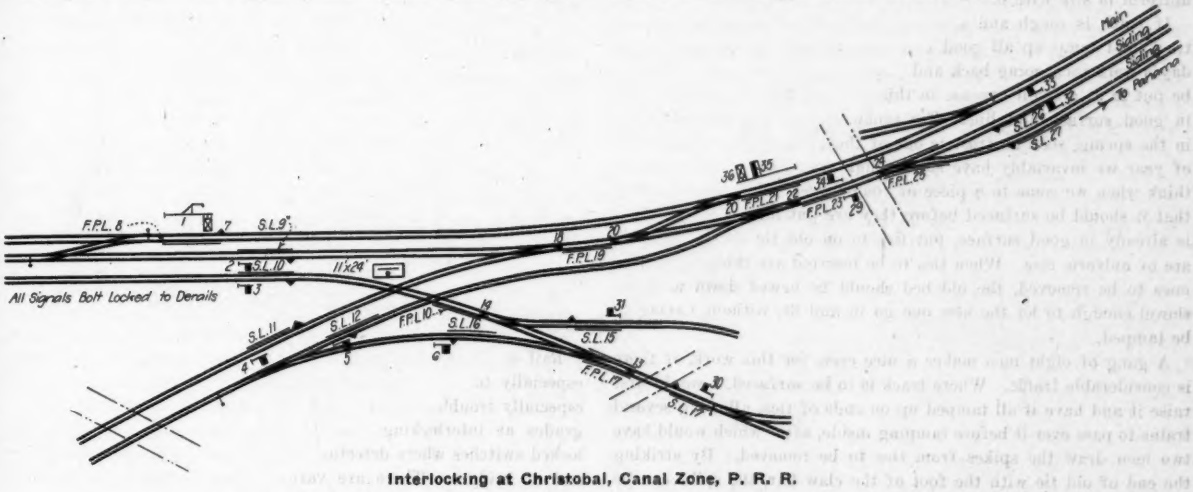
The night indications are: clear, green; caution, yellow; stop, red. R. S. A. lamps with special long-time burners furnish light for night indications. Marker lights are not used.

Track circuits are supplied with current from two cells, 400 A. H.-B. S. Co. in multiple. The track relays are 4 ohm model 9-C, U. S. & S. Co. Line relays are 1,000 ohms and are of the same type.

The route locking is accomplished by means of a slow-speed mechanical time lock. Detector bars 55 ft. long are located at each track function so that each function is mechanically locked while a train is passing over the plant.

All ground and tower wiring is in trunking. Boot-leg wires consist of No. 6 B. & S. gauge, copper-clad. The lead wires from track and battery, to signal apparatus, are No. 8 B. & S. gauge Kerite. The leads from line to signal apparatus are No. 12 B. & S. gauge Kerite. The pole line consists of open wire, No. 10, copper-clad, W. P. insulation. The tower wiring is No. 12 B. & S. gauge kerite. All jumpers on relays consist of lamp cord with 2/64" wall of rubber insulation. No lightning arresters are used.

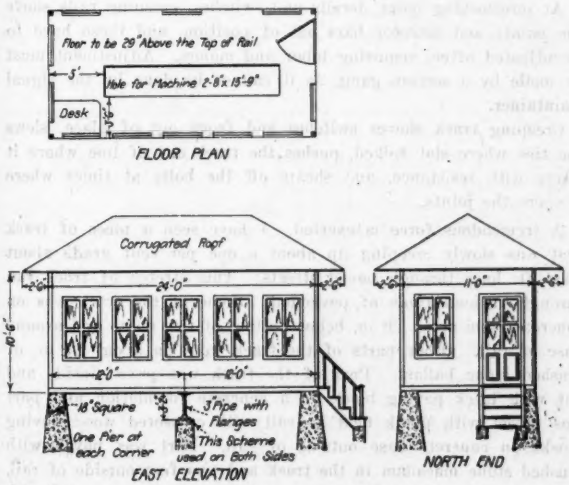
The interlocking cabin, which is 11'x24'x10' 6" high, is shown herewith. It is supported on concrete piers, one at each corner.



Interlocking at Christobal, Canal Zone, P. R. R.

The mid-section of the tower is supported at the sides by 3-in. iron pipe, having top and bottom flanges as shown in the plan. The floor is 29 in. above the top of rail.

We are indebted to Mr. W. H. Fenley, superintendent of telegraph and signals of the Panama R. R., for the plans and information herewith.



Interlocking Cabin, Christobal.

The Grand Trunk will start work soon on the construction of the Toronto union station, which was projected some time ago.

The Great Northern has started work on its ocean and rail terminal at Flavel, Ore., at the mouth of the Columbia river.

The Illinois Central has applied for permission to erect a new bridge at Blackfort, Ky., it is reported.

The New York, New Haven & Hartford has given a contract to C. W. Blakeslee & Sons, for the foundations of a passenger station to be built at Pawtucket.

The Norfolk & Western will build a passenger and freight station at Charlestown, W. Va.

The Northern Pacific will shortly resume work on grade separation in Spokane, Wash.

The Northern Pacific and the Spokane & Inland Empire will erect a union depot at Coeur d' Alene, Idaho, it is said.

The Oregon-Washington R. R. & N. contemplates a roundhouse, shops and yards at Pendleton, Ore.

The Pennsylvania has awarded a contract for a seven-span bridge over the Schuylkill river at Earnest, Pa., to the Phoenix Bridge Co.

Omaha, Neb.—The Rock Island Omaha Terminal Company has been incorporated to operate a railroad in Douglas county, Neb., and terminal facilities for the Chicago, Rock Island & Pacific.

The Southern has awarded a contract to the Koehler Bros. & Fowler Construction Co., Memphis, Tenn., for the construction of the viaduct over its tracks. It will cost about $50,000.

The Maintenance of Way Department

TIE RENEWALS.

V. H. Shore, Foreman.

My method of renewing ties differs some from those of a great many foremen. I notice that not a few foremen would put in ties on the old tie bed without regard to track conditions, which is a quick way of getting your ties in the track and would look like a cheap plan but would be expensive in the outcome if riding conditions of track were poor when ties were inserted.

The method of putting in ties on an old tie bed is good, providing the surface of your track is good, and ties to be inserted are uniform in size with old ties taken out.

If track is rough and needs surfacing my plan is to raise my track and tamp up all good ties first, pulling up enough for the day's work then going back and putting in the new ties. Ties can be put in at a small expense in this way and the track is also left in good surface and line. Tie renewals should commence early in the spring, soon as frost is out of the ground, and at this time of year we invariably have some rough track. For this reason I think when we come to a piece of rough track when renewing ties, that it should be surfaced before they are put in, and where track is already in good surface, put ties in on old tie bed where they are of uniform size. When ties to be inserted are thicker than old ones to be removed, the old bed should be hewed down with the shovel enough to let the new one go in and fit, without having to be tamped.

A gang of eight men makes a nice crew for this work, if there is considerable traffic. Where track is to be surfaced, I would first raise it and have it all tamped up on ends of ties, allowing several trains to pass over it before tamping inside, after which would have two men draw the spikes from ties to be removed. By striking the end of old tie with the foot of the claw bar, the spike can be started, and then drawn easily. Pulling the spikes takes but a short time and men can then be brought back to assist the rest of men changing them out. I have men work in pairs when inserting and tamping up new ties.

After old ties are renewed and spiked up, track is lined, filled in and dressed, completing the day's work.

Where track is in good surface, would put in ties on old tie bed, having two men first draw the spikes while the rest of the men remove the old ones. By jacking the track a little most all the old ones can be drawn out with picks without digging, especially sawn ties, and new ones inserted.

Care must be taken in certain kinds of ballast or track will get humped when putting in ties by this method. The safest way is to raise the spikes a little on several ties each side of those to be removed, so that ballast cannot run under them when rail is raised. Two jacks should be used in this work, on opposite sides of track.

The method outlined above would necessitate keeping some of the ties on hand longer than other methods, but would be cheaper and more satisfactory at the end of the season. The condition of a tie can be more easily ascertained where track is raised than where it is not, which is an important point in favor of this method of renewing.

RAIL CREEPING, NO. 9.

L. T. Wallin, Extra Gang Foreman.

I note in your March issue the letter signed by Amin Chand Kapur of the Jullunder Doab Ry. of India, and I wish to make known my experience with rail creeping problems which may be of interest and use to that writer.

I find that the creep takes place under traffic and a certain per cent due to the expansion of rail, more especially where the rail has the opportunity of running down grade. The contraction has not sufficient force to move the rail back upgrade to its original position. Where trains are operated on single track, I often find that one rail will move in the opposite direction to the other, where the track is level, but my experience has shown that rail will not creep in opposite directions if track is kept well surfaced and not allowed to get center bound. For the latter reason I always leave six inches in center of track untamped, whether ballast or soil track. Creeping will always go with the traffic, never against it.

The only effective way to prevent creeping is by the use of anti-rail creepers; any simple device that will catch the rail positively and hold will answer the purpose. They must be applied according to the amount of traffic, whether ascent or descent of grade, single or double track. I can safely recommend the following:

"Where traffic is heavy on a descending grade, running in one direction, six anti-creepers to be used for every rail, two in each center, opposite joint if rail is laid over broken joints, and two in each quarter about three ties apart or placed wherever the supervisor thinks best."

The above may be used as a maximum basis for all other conditions, decreasing the number for each rail according to the amount of creep taking place. As a general rule not less than two anti-creepers should be used to each rail; less that number is not usually found to be effective.

RAIL CREEPING, NO. 10.

O. A. McCombs, Roadmaster.

Rail creeping has always been a great annoyance to track men, especially to those who have charge of track maintenance. It is especially troublesome at railroad crossings, at the bottom of long grades at interlocking derails where points are used, at interlocked switches where detector bars are used, at frogs and switches and at bridges. There are various other places where a slight movement of the track longitudinally puts other attachments out of adjustment. It opens joints at some places and closes them at others.

When the rails creep at railroad crossings it is continually and slowly pushing the crossing out of line, and the track foreman must frequently line the crossing at considerable labor and expense; the place must be watched carefully to see that crossing does not get so far out of line as to be unsafe for traffic.

At the bottom of long grades the creeping rails close the joints tight. If the joints are close in cool weather, and the heat of the summer sun warms these rails, there is danger of sun kinks if there are any weak places in track. Such places should be watched closely in hot weather, and when the pressure becomes too great it should be relieved by cutting out a piece of rail before the sun kink occurs.

At interlocking point derails and switches, creeping rails shove the points and detector bars out of position, and these have to be adjusted often, requiring labor and money. Adjustment must be made by a section gang, as it cannot be done by the signal maintainer.

Creeping track shoves switches and frogs out of place, slews the ties where slot spiked, pushes the track out of line where it meets with resistance, and shears off the bolts at times where it opens the joints.

A tremendous force is exerted. I have seen a piece of track that was slowly creeping up about a one per cent grade about 2600 ft. long through paved streets. This stretch of track ran through various kinds of pavement. Some of the track was on concrete from about 20 in. below bottom of ties up to and around base of rail. Other parts of the track were on about 14 in. of crushed stone ballast. Part of the track was paved inside and out with brick paving block on a concrete foundation and part was paved with plank next to rail with creosoted wood paving blocks on concrete base outside of rail. Part was paved with crushed stone macadam in the track and two feet outside of rail, level with top of rail. This piece of track was constructed with

75 lb. rail, six-hole 40 in. angle bars, slot spiked, with oak ties spaced 20 in. center to center. Against all the resistance the track was slowly creeping up grade in the direction of traffic.

The regular traffic here was all one way and consisted of five through freight trains of 1200 tons each; two local freight trains of 1000 tons each; four heavy through passenger trains; five light passenger trains; two motor trains; and in addition to these there was a number of switch and extra trains. The through trains were pulled by heavy consolidation engines, the light trains by lighter engines.

There was no danger to traffic at this place, as the creeping was very slow, but there was continual trouble and work to keep street car crossings, frogs and switches in place.

I had charge of a piece of track at one time where there was considerable trouble with creeping rails. It was a double track, traffic in one direction only on each track. The rails were 56 lbs., 30 ft. lengths, with 18 good post oak ties to the rail. Four-hole, 24 in. angle bars were used, slot spiked at joints, and the ballast consisted of about 12 in. of gravel. The rail was creeping badly and pushing a railroad crossing out of line, in the direction of traffic. The grade from about 2000 ft. was 0.25% down grade to within 400 ft. of crossing, then upgrade about 0.5% to 1000 ft. west of crossing. The crossing was in a light cut and on each side for the entire distance of the trouble the track was on a light fill. The crossing was interlocked and trains did not stop at it.

The foreman would frequently have to cut rails on the east side of the crossing, line crossing back to place, and put in longer rails on the west side of crossing. The joints would open up about 2500 ft. east of crossing, often shearing off the bolts. The foreman would close up the open joints and put in longer rails.

This was a comparatively new track, being the second track built, and the roadbed was not as solid as the other track, which had been built a number of years before.

The foreman in an effort to hold this after lining the crossing back, put a rail in tight on the west side, tightened spikes and bolts, slot spiked each joint, and spiked a floor of crossing plank in track against the crossing on the west side. These plank fastened about eight ties to the crossing in addition to eight crossing timbers 10"x10"x10'. Still the rail crept and shoved the ties, timbers, crossing and all along with it.

The danger to traffic here was in shoving the railroad crossing out of line for the neighboring road. This had to be watched closely, as one of the double tracks crept in one direction, and the other crept in the opposite direction.

Finally, after a great deal of effort to hold this track without them, the foreman put on anti-rail creepers. They were put at quarters and centers, eight to a rail of track. The track was laid broken joints; two anti-rail creepers were placed opposite the joints in centers of rails, and one in each quarter. These anti-creepers were placed about 300 ft. each side of crossing, all placed so as to hold the rails from going west; expansion was closed up, spikes driven down snug, bolts all tightened, ties renewed where needed, and track put in good shape. I was familiar with this track for a year after these anti-creepers were applied, and there was very little trouble with creeping rails there during that time.

The traffic on this track, all one way, consisted of four heavy through passenger trains, one light passenger train, five through freights, each pulling 1000 tons, one local freight of about 700 tons, two motor passenger trains and a number of switch trains and extras.

The locomotives ranged from the light engine pulling the light passenger trains to the large consolidated type D 10 pulling the through freights and passenger trains.

The parallel track at this place was built of 30 ft., 75 lb. rails, 40 in. six-hole angle bars, 18 post oak ties to the rail, 12 in. rock ballast, slot spiked at joints. Grade was down about 0.5% in the direction of traffic. The subgrade had been in use a number of years and was solid. Traffic about the same as on the other track, all in one direction.

There was comparatively little trouble on this track with rail creeping. Anti-rail creepers were applied, however, about 300 ft. each side of crossing in the same manner as on the other track, and this eliminated the little trouble at that place.

Another piece of track where I have had considerable trouble with rail creeping was at a railroad crossing about 50 ft. from the end of a 1200 ft. bridge. The track on this bridge not being anchored, was continually creeping in on the crossing and shoving it out of line. The crossing was not interlocked and all trains had to make a full stop. It was at the edge of a town, and trains coming over the bridge at full speed and stopping at crossing, drove the rail ahead of them. Trains going out proceeded at reduced speed until they passed the crossing.

After frequently driving the crossing back to line and cutting and putting in short rails on one side and longer ones on the other, anti-rail creepers were put on near the crossing on rails not on the bridge. One anti-creeper was applied on every other tie between the crossing and the bridge, about 50 ft., and on about 100 ft. of track east of crossing. The anti-creepers east of the crossing were set against switch timbers in rock ballast. The track just east of this crossing was very well anchored, as it was only about 150 ft. from three other railroad crossings, all connected together. Some anti-rail creepers were put on west of the bridge to hold the track from creeping in on the bridge, but these were useless there, for the track would open up joints on the west end of bridge and close up tight on the east end and against the railroad crossing.

We were trying to hold this rail from creeping and still maintain sufficient expansion on the bridge to keep the rail from buckling when expanded by the heat. Finally, after putting in a new crossing and lining to proper place, all the open joints on bridge were closed up tight from end to end, and all bolts were tightened so that there were no loose joints.

Several months afterwards, when I examined this place, the crossing had not been shoved out of line and the track at the west end of the bridge was creeping slightly west, in the opposite direction to what it had been creeping.

The danger at this place was in the creeping rails pushing the crossing out of line, and the crossing was so strongly braced on the east that the creeping rails had forced it together until the gauge was dangerously tight.

The above was single track, with traffic as follows: Ten through freights, five each way, 1200 tons each; four local freights, two each way, 900 tons each; eight through passenger trains, four each way; four light passenger trains, two each way. Locomotives ranged from large consolidated engines pulling the through passenger and freight trains, to smaller engines pulling the light passenger trains and local freights. In addition to above there were numerous switch trains going to and from industries nearby.

Rail creeping is a subject that presents so many different phases that it is hard to analyze it and present definite facts, causes and remedies in general. I have never been able to determine to a certainty why on some pieces of single track one rail creeps one way and the other rail creeps the other way; nor why one rail creeps faster than the other in the same direction at places, although I have often noticed the above conditions.

Some of the principal causes of creeping track are as follows: Traffic, loose joints, changes in temperature, and bad, irregular track. There are probably other minor causes, but these are the main causes.

Bad, irregular track will creep worse than good track. Track that is loose at the joints and with rails loose on the ties will creep badly under traffic. Changes in temperature, I think, are sufficient to move a loose track down grade without any traffic on it. In the cool of the night the rails would contract, and as the least resistance would be down the grade they would contract a little more down the grade than up the grade. The heat of the sun the next day would expand the rails and they would expand down the grade a little more than up the grade, as the least resistance is down. Now if there are any open joints at the bottom of the grade, the rails will creep down and close the

joints tight. With traffic they would creep much faster, however.

We can get rid of neither the traffic nor the changes in temperature, but if we can remedy bad, irregular track, we can reduce creeping to a minimum.

I know of stretches of track where everything is in good shape—good ties and ballast, good drainage, good line and surface, good gauge, with traffic all one way—where the creeping is very slight. It could only be determined after long periods of time by careful measurements. And I have seen other pieces of bad, loose, single track where you could see after a train passed that the rails had been driven with it. And when another train passed in the opposite direction you could see that the rails had been driven back the other way.

To reduce rail creeping to a minimum, or to prevent it, we should have good track, bolts all tight, good ties and ballast, spikes all driven down snug, and expansion at joints closed to a minimum.

At places where rail creeping is excessive and troublesome, if anti-rail creepers can be applied, they will reduce the trouble materially. The heavier the rail, other things being equal, the less creep in rails.

Wherever rails are known to creep excessively, and make trouble, inspection should be made often and carefully, especially in hot weather, so that a remedy may be applied at the first indication of danger to traffic.

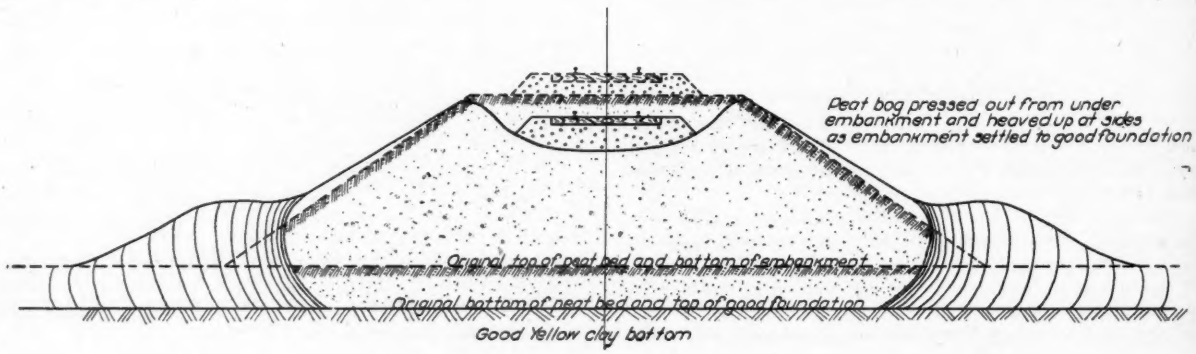
substance that can be used to stop slides on the fills, because they absorb the water and will make the bank solid quicker than a heavier substance. Raise the outside grade about two inches higher than the inside grade every time the track settles, and it will settle to permanent bottom in time. I find no material for taking care of slides to be better than engine cinders.

On single track where there is a slide throw the track to solid side of fill, so that the trains can keep moving and at the same time work of filling in the slide can be carried on.

P. R. R. GRAVEL PLANT.*

Unloading Crane, Formerly at Balboa, Now in Service at Gamboa Gravel Bins.

The unloading crane at the Panama R. R. gravel-handling plant, on the bank of the Chagres River at Gamboa, was recently placed in service, and is now delivering gravel into the storage bins at the rate of two barge loads a day. The crane is one of the three sand unloaders formerly in use at Balboa in the Punta Chamé service. It is operated by electricity generated by a 300-kilowatt motor-generator installed in a building of temporary construction, situated about 100 yards distant from the unloading plant. The machine was formerly used by the McClintic-Marshall Construction Co. in its machine shop at Gatun Locks. In addition, the power plant is equipped with a 175-horse-


Peat bog pressed out from under embankment and heaved up at sides as embankment settled to good foundation
Original top of peat bed and bottom of embankment
Original bottom of peat bed and top of good foundation
Good Yellow clay bottom
Heavy dashed lines show embankment as originally constructed. Heavy solid lines show position taken by embankment and the upheaval of peat bed at sides due to settling of embankment under heavy traffic

Roadbed Over Peat Bottom.

SINK HOLES OVER PEAT-BOGS.

By D. O'Hern, Roadmaster.

I have had a piece of track settle in a peat-bog bottom 400 ft. long. Peat-bog runs from four to six feet thick; the peat is light substance and when dry will burn. This track settled after being in service about a year. When the track settled the peat-bog heaved on both sides of the track. We kept unloading sand in this place until the peat-bog was crowded out and until we struck solid bottom. We kept trains in service at all times under a slow order. Sometimes these sink holes are so serious we have to drive piling to make a temporary trestle. Then we would have to unload sand, rubble stones or heavy materials in order to crowd out the lighter substances and reach a solid bottom.

The sink holes and peat-bogs cause trouble when water stands around the track and necessary drainage is lacking.

Slides are mostly caused by heavy rains on high fills made of clay and quick-sand. They occur more frequently on second track work, because in building second track the inside portion is solid next to old main, and the outside fill is weak, causing the track to settle, and heavy rains cause the slides. These fills have to be watched very carefully and as soon as the settling is noticed engine cinders should be put in as they are the best

power Buckeye tandem engine, formerly used in the pumping plant on the bank of the Chagres River at Gamboa, and prior to that time in the old planing mill at Empire; and a boiler, formerly belonging to railroad locomotive No. 203. The latter is provided with oil-burning apparatus, the oil being supplied from a small tank located on a hill nearby, which, in turn, is supplied direct from the oil company's main.

Until recently, gravel has been unloaded from barges by a locomotive crane, and the demand to date has about kept pace with the supply, although a small amount has been placed in the storage pile, just south of the bins. Gravel is dredged and brought to the unloading dock by floating equipment of the Dredging Division. Dredge No. 1 is engaged in this service, and is now working in a gravel bed a short distance up the river from the site of the old town of Cruces. When the gravel dredging operations were first begun, it was found that the dredge buckets brought up the material in so dry a condition that the chute frequently became clogged. In order to remedy this difficulty, two jets of water are made to play under pressure continuously on the material as the buckets dump it into the chute, which serves to wash it down into the barges. When the barges are full, part of the water is expelled naturally over the sides, and

*From "The Canal Record."

the remainder is siphoned out. Threee barges, one of 600 cubic yards capacity, and two of 500 yards capacity each, together with the tug *De Lesseps*, comprise the remainder of the floating equipment in this service.

With the unloading crane operating steadily, it is expected that two or three barge loads of sand will be handled daily, except Sunday. The bins have a capacity of about 2,000 cubic yards, and are similar in construction to the sand bins at Balboa. It has been found, however, that the valves which control the flow of gravel into cars underneath the hoppers frequently become clogged on account of large stones in the gravel, and to obviate the loss of time in dislodging them, the openings will probably be enlarged.

The force employed on the floating equipment consists of three gold, and 38 silver employes; and at the unloading plant and generator room, three gold, and eight silver employes. In addition, there is train service attached to the plant, with a regular qualified train crew. About six dump cars are used about the plant in transferring gravel to the storage pile, etc. The foreman of the plant is Mr. A. B. Kratz, who occupies married quarters converted from the building formerly occupied by the Panama R. R. as a signal station, and known as Tower R. The most of the silver men at the plant live in box cars, while the men of the floating equipment eat and sleep on board. It is probable that gravel dredging operations will continue for a period of about two years, and a large amount will be stored against future requirements.

CORRESPONDENCE.

Difficult Crossing Renewal.

The diagram herewith illustrates a problem in the renewal of a double crossover containing eight frogs. The frogs are all number tens, and are located on a very narrow right of way, fence lines being only 30 ft. apart, on property lines.

This crossing was to be renewed, and the time available was from 12:20 P. M. to 3:26 P. M., at which time it was necessary for

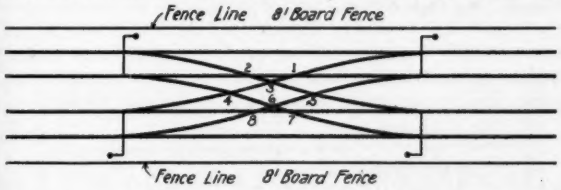


Diagram of Track Layout, Showing Difficulty of Renewal.

the track to be in condition to let a train pass. The ballast was stripped out to the bottom of ties before the crossing was torn up.

How would you proceed to retie, relay and reballast it—practically reconstruct it?

How many laborers would be required?

How long would it take? L. H. S.

THE TERRY STEEL TURBINE CO., Hartford, Conn., announces that it has recently installed additional machine tools in its plant, increasing the capacity by, approximately, 25 per cent.

THE U. S. METAL & MANUFACTURING CO., of New York City, has discontinued its eastern agency with the Pollak Steel Co., of Cincinnati.

THE TITANIUM ALLOY MANUFACTURING CO. has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. Wm. M. Corse, formerly works manager of the Lumen Bearing Co., Buffalo, N. Y., and lately general manager of the Empire Smelting Co., Depew, N. Y., will be associated with the company as manager of this department.

The Seattle office of the AMERICAN HOIST & DERRICK CO. has been moved from 613 Western avenue to 1512 L. C. Smith building. The L. C. Smith building is one of the highest and best equipped office buildings in the country, and its central location will be more convenient for out of town customers.

EXAMINATIONS, THEIR USE AND ABUSE.

By C. Clay.

Are you examining your section foremen when promoted or hired or has this phase of the section foreman problem never occurred to you? Can your section foremen take an examination and pass creditably? Are you certain that your foremen are conversant with the rules relating to train operation with which they may come in contact during the course of their work? Did these questions ever occur to you? If not, just read them over again and then call to mind some circumstance that has happened and see if you can arrive at a definite answer as to what each foreman would do under the circumstances.

Suppose that we take a hypothetical situation. Picking up three cars on the head end the brakeman overlooks coupling up the air hose, a coupling slips by, or a dozen things may happen to cause a break-in-two. If this happens on a grade, the head end has got to keep out of the way. After the head end goes and a section gang starts work, what happens? This occurrence might appear unreasonable, but undoubtedly you can call to mind similar happenings.

How many laborers have you who will some day be foremen who cannot tell you what a rear end marker is or what it indicates? Do they know the classification signals and what they indicate? Have they or the foremen a thorough knowledge of flagging and distances? It is difficult to tell unless the men have been examined, until something happens and then the happening is usually disastrous.

An examination can be very useful, but if made too rigid it may stand in the way of promotion for a thoroughly competent man. In one location I call to mind that examinations held four years ago showed a very poor interpretation of the rules by the men. In more recent times the men seeking promotion can pass a creditable examination because they know that it is necessary. The four years has made a marked difference—four years ago they guessed while today they know. Examinations can be abused by taking a book-of-rules and asking the man questions, expecting to get the answers as given by the actual rule. The word abuse is used advisedly. If you ask for the actual book wording you will get it, because the men will study the book of rules for these answers instead of applying them to actual conditions. Of what use is a stereotyped answer? It does not disclose the amount of the knowledge of the man—it merely shows his ability to commit a rule to memory, but fails to disclose whether he can give a literal interpretation of it.

Possibly it is quicker to run through the book of rules because there would then be fewer questions asked than if the questions were asked with relation to the actual work and actual location of the person under examination. Generally there is a printed set of questions for examination and these have to be answered in the person's handwriting. This should be followed by oral questioning fully covering the location and work in which the party will be engaged. Looking at the book of rules you find that a station stop calls for a green and white combination flag (in the generally accepted standard). Ask a man what the station flag is and you are answered. But ask him what a green and white combination flag is for, and you might be surprised to be told that it covered a second section following an extra train. The latter answer has been given when examinations were new. Just that one answer will show why it is necessary to ask the man for a literal interpretation of his knowledge rather than a rendering of the book rules.

With our high speed trains, signals and flagging are highly important, and are becoming more so every day. If you use slow flags, are you sure your men know the proper location and distances for them? A double header freight derailed last year 100 or 200 miles from Chicago, where the section men were changing out a rail. Being within a few miles of this I was informed on creditable authority that the flagman was out not to exceed a quarter of a mile and made no motion with his flag. I do not know what finding was made at the investigation, neither do I know whether the foreman or rather two foremen with the two gangs had been examined.

But the fact remains that there must have been an element of doubt somewhere of the capabilities of the men, for such a statement to gain ground after having been made. I have yet to find a flagman who will let a train go by without making a motion with a flag, be he ever so ignorant. It is the foreman's place to know that the flagman is competent. The roadmaster should know that the foreman has the knowledge of flagging requisite to enable him to send the right man and instruct him as to methods.

In the case quoted above no mention was made of torpedoes and it is presumable that none were used, although they should be used when flagging. Whether the foreman has a knowledge of where and when these should be used can only be brought out in an examination. There are also locations which, if the flagman was placed at a specified distance, would obstruct the engineer's view of him and give a shorter flag. A stereotyped answer on a question such as this would leave a doubt as to the foreman being able to give it a correct translation. Flagman may be out the specified distance, but at the wrong end of a curve, and for such things the foreman is held responsible. Of course there is always the question of the foreman properly instructing the flagman. I have found a flagman walking in and within 500 feet of a gang with the track open, because he figured it was nearly time to go home. The man had been properly instructed and no examination will cover such circumstances as that. However if such matters are brought out at an examination, it brings to the prospective foreman's attention the fact that beyond sending out a flagman he has to watch him. Such a thing may never have come to the man's attention as a laborer. The use of an examination is more to show the knowledge the man has of his work with relation to the operation of trains, than to show how he can do work.

No oral examination will serve to show what kind of work a man can do, but it will show how he would act if an emergency arose which necessitated radical action. A man can plug along in the same old way day after day, when a foreman, as the foreman under whom he worked, did. But should an emergency arise could he meet it? Any happening out of the ordinary is apt to throw a man off his balance, and as he is located at a distance from his superior officer, he must of necessity be a man who can meet an emergency without getting rattled, one who will act in a safe and sane manner. No questions from the book of rules will cover this and the only way appears to take a supposititous emergency based on fact and applied to some location with which the man is familiar. His answer as to the way in which he would meet the situation or situations will serve to show whether the man can handle one with despatch, and figure things out for himself or whether he will leave the handling to instinct.

Do not ask each man the same questions, or men will develop who will answer all of your questions, as foremen communicate with each other. Make the examination as instructive as possible, and if the man is puzzled by a question show him how to figure his way out of it. If he seems dull in his answers, show him the reason for such things and he will be able to reason others out for himself. A man who can reason for himself is away ahead of the man that follows instinct engendered by that which he has seen done before, for after any unusual happening such a man is at a loss what to do. He wires to the office which in the majority of cases is as much at sea as he is, and it then becomes a matter of locating the roadmaster, unless the yard foreman is handy and the problem can be put up to him. If there is anything serious the matter, the track is tied up. With native-born foremen, the larger number are ready to meet anything that happens. But today we have foremen who speak all tongues and a large number of these have what might be termed a one way brain. It will follow the usual processes but beyond that there is a blank. This emphasizes the need of an examination. Your men do work in a certain way because they have seen it done that way, but do they know the reason for doing it that way? The reasons can be brought out and shown.

For instance suppose a foreman had to take a rail from a passing track to replace one in the main track. If the rail on all of the side track is of the same weight as the main track he would probably as a matter of instinct take one from near a switch. But could he explain that to take one from near a switch was the better way because by spiking that switch it would still permit the use of the track by the switch at the opposite end?

Naturally such things might not happen in a lifetime and yet again they might frequently. One might continue at great length quoting instances but possibly the foregoing will serve the purpose of showing that examinations should be made.

It has been shown by examinations that it is a good rule to have the foremen, when receiving a circular letter, read it to the men before going out to work. In this way the men become as familiar with the extra rules as the foreman, and when called up for examination the new men are conversant with current instructions.

Make the examination cover every thing with which the man may come in contact. Be careful that the man thoroughly understands the why and wherefore of his answer. Have him explain his answers and do not put your questions in the manner of asking questions, but talk to him in an easy conversational manner and you will get far more information from him. Do not overlook that he is up against something that is strange to him and that he is undoubtedly nervous. If you set him at his ease when starting you will be acting with more fairness to him and yourself. If a man shows signs of nervousness it is more a matter of anxiousness with him, and when at ease such a man can generally give excellent answers. On the other hand, the man who enters looking as if the thing was a joke is usually the man who is determined to bluff it through and cannot give very good answers, so it is always worth while to set a nervous man at ease.

There would also appear to exist a reason for examinations after a man has been in service some time, as man is prone to forget with long usage and some rules may be overlooked owing to their existence having been forgotten. An examination, say, one or two years after the first, might be of great benefit in calling to a man's mind things that had been forgotten. Circulars in this case do not serve the purpose, as the man that remembers resents them, and the man that has forgotten sees it is a circular and without reading it throws it away. Periodical examinations, at stated periods, (less than a year does not seem advisable,) would therefore seem to be of benefit. The men however, should not be gathered in a body for this purpose, as the wise man that does not know keeps quiet and his lack of knowledge is not noticed. Individual examinations should always be given so that the knowledge of each man is apparent.

CARE AND OPERATION OF ORDINARY HAND CARS AND SPEEDERS.

C. E. Foreman.

It hardly seems necessary on first thought that the simple care and operation of ordinary handcars and speeders (velocipede cars) need be commented upon. But the scarcity of easy running and properly cared for handcars which a foreman finds as he moves from gang to gang and railroad to railroad would seem to indicate that there is something radically wrong somewhere. The majority of men dismiss the subject by assigning the reason of "carelessness and neglect." True, this forms a large percentage of the trouble, but my experience teaches that not less than 50 per cent of the trouble is due entirely to ignorance. Many handcar and speeder "pumpers" are perfectly willing and would be anxious to properly care for their cars if they knew how to put them and keep them in any easy running shape, so as to lighten the labor of pumping. A few suggestions follow.

Most handcars are manufactured with a view to light running, and consequently the majority of new cars when received are squared up and true. However, if not, they should be tuned up by loosening the bolts which fasten the boxes in which the axle revolves and moving one end of the axle forward or back to a position where there will be no tendency for the flange of any of the wheels to bind against the rail when the car is moved forward on straight track. (See Fig. I.)

Flanges binding against the rail cause more hard pumping than any other single defect. When axles are in proper position,

tighten the bolts firmly and see that they are kept tight. Handcars should be tried out frequently to see if they are "true," as setting cars off and on the track, pushing them loaded with tools over highway crossings, rough handling, etc., is very liable to loosen and move the boxes from their proper positions.

Binding may also be caused by a wheel not running parallel to the track, although the axle may be in proper position. (See Fig. II.) This, in a new car, is clearly the fault of the manufacturer and should be remedied in a shop. Binding occasionally is caused by a crooked wheel or "a wheel which has the snakes." If the wheel cannot be straightened and trued up a new wheel should be obtained.

Most handcars have their "Front" and "Rear" ends marked, and if the wheels and axles are properly trued up the car will always run lighter when placed on the track with the "Front" end in the direction of travel. This is especially true when running around curves. All wheels except the "loose wheel" should be keyed tightly to the axle and not allowed to work loose or get out of position so that they bind. The loose wheel should be painted a conspicuous color or otherwise marked so as to be readily located, and then the car can be turned by lifting the end opposite that which the loose wheel is on. Proper lubrication of the loose wheel makes pumping easier around curves on account of the unequal distance traveled by the inner and outer wheel.

Next in importance to binding comes grinding. Grinding in the bearings may be due to lack of oil, but it is safe to say that more frequently it is due to dirt and sand in the bearings. Hand cars should never be used to transport sand and gravel with, but

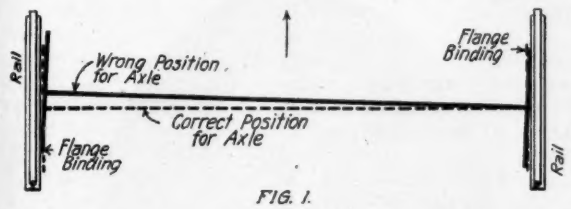


FIG. 1.

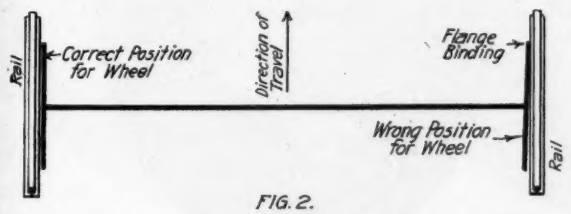


FIG. 2.

in case it is done, the bearings and oil holes should be protected from all dirt and sand.

Exterior surfaces around bearings and oil holes should be kept clean of oil and grease and the consequent accumulation of dirt. Never oil the cogs of the gear wheels in either a speeder or handcar. While good clean oil will reduce friction between the cogs, the oil will also cause an accumulation of dirt, sand and cinders, and before long the teeth will be choked with a hard, gritty mass that will cause the car to drag, even down grade.

Bolts and screws holding the frame together should be kept reasonably tight, but should never be turned excessively tight, especially where the heads or nuts and washers sink into the wood. Unless the nuts on the underside of the platform are tightened occasionally, especially those with which oil comes in contact, they will jar loose and the lower half of a bearing box may drop off unnoticed.

The care and operation of speeders (three-wheel velocipede cars) requires more attention than the heavier four-wheel handcars. Binding here is more frequent and, since usually only one or two men are pumping, more noticeable. Fig. II represents the conditions ordinarily found. The front wheel on the load-bearing side (right side) should be very slightly turned toward the rail, as shown, exaggerated, in Fig. II, but should not bind enough to make pumping difficult. This position of the wheel is necessary in order to make certain of the car keeping the rails when going around curves to the right, especially if the curvature is sharp. If the speeder is to be used only on tracks having very light curves the wheel can be advantageously placed parallel with the rail and it will be found that the car will keep the rails unless there are other faults, such as sprained or badly worn frame or parts, etc.

Speeders, which are necessarily built light, should be handled with more care than heavy handcars, as shocks and derailments are liable to cause sprains or breaks. While these damages may be repaired, it is usually found that the car does not run as easily as before, on account of failure to restore exact former conditions. Rough usage in loading and unloading speeders for shipment is frequently the cause of a car running heavy. Personal attention to this feature, instead of leaving it to the baggageman or freight handlers, will lessen the labor of pumping.

A speeder which is used regularly should be cleaned periodically. The ball bearings and retainers should be removed and thoroughly cleaned with kerosene. Examine the bearings for rough spots and if found replace with new parts. When replacing, pack the ball bearings in a generous amount of clean vaseline.

Under heavy loads or usage a grinding or "screeching" will sometimes develop in the wheel bearings, although they may be well oiled. This denotes a worn retaining cup or a broken ball bearing. These should be replaced at once, else the damage will spread to all the ball bearings, the cups and the axle, besides increasing the labor necessary to propel the car.

Attention to the details mentioned, by the man who has considerable pumping to do, will result in the saving of a great deal of unnecessary hard labor. The writer has found this to be true by trying it out. In one season from March to September, inclusive, the writer has, with a partner, covered over 2,500 miles on a No. 3 velocipede car. By keeping the car in proper condition a mileage of 56 miles was made in one day, and 65 miles the following day; these distances being over ordinary track and grades, including the climbing of a long divide; one day facing a "head-wind" and the following day pumping with the wind.

The "head-wind" always has been and always will be the pumper's worst enemy. We cannot control it; but we can control the condition in which we keep the handcars and speeders which we pump every day.

TAXING TIMBER LANDS.

Mr. E. L. Powell, in a paper read before the Louisiana Engineering Society on "Timber Conservation and Preservation" in the United States, gives the following interesting comment on the effect of taxation on the growth of timber:

"Taxation must be carefully considered and its relation to the forests determined before a general plan of re-forestation can be laid out. A complete revision of our taxing system as it relates to forest lands must be considered and made effective. . . . The rate of increase in value by growth of timber is not sufficient to pay for the care of the forest, interest on the money invested in the land and the growing crop, and in addition taxes at current rates. The interest on the taxes alone would, in many instances, amount to the full value of the crop of timber when harvested. Land upon which timber is growing, or land when set aside to be planted with timber, should be entirely exempt from taxation and all timber should be taxed when cut and marketed. As the tax laws are at present, the owner is practically forced to cut and market his timber as soon as it is large enough to sell, even at a low price, thus absolutely placing a premium upon the cutting, or rather forcing the owners to do that which they should not do. In European countries, the problem has been solved by the government taking over and controlling the forest lands, thus providing the necessary money for the ownership and growing expenses out of the public purse. Being publicly owned, there are no taxes and in this way, even such thickly settled countries as Germany and France, are to a very large extent producing their own timber and at reasonable prices."

SECTION GANGS FOR ALL REGULAR MAINTENANCE WORK.

By C. E. Thompson, Foreman.

The extra gang is all right in its place, but each section gang should be large enough to handle all kinds of general section work without aid.

We find it to be a fact and it stands to reason that a man will take more interest in his own work at home than he will on a neighboring section. Therefore, for that reason, the writer does not favor combining section crews.

Relaying steel and reballasting should be done by extra gangs. Extra gangs are not as efficient as section gangs as a whole, due possibly to the fact that there are more men in the gang, and it is impossible for the foreman to give as much attention to each man's work as he could in a smaller gang. Therefore we find their work does not stand up as well as work done by regular section gangs, and the work of extra gangs is many times so inefficient as to make it uneconomical. The advantage of having section gangs large enough to handle all kinds of work in case of accident, such as washouts, is that many times section foremen would be able to repair damage to track and get trains over before the extra gang could get there, and thus avoid the delay of traffic.

There is more difficulty in obtaining extra gang than regular section men. In the first place, in procuring extra gangs you take the gang as it comes to you and there are always some of them who we sometimes term "dead beats," and as a rule we are compelled to keep them or lose the whole gang.

An extra gang foreman should be a man of experience in all kinds of track work, and also understand handling a large number of men to the best advantage. There are some section foremen who will do excellent work with small gangs who would be total failures with large gangs.

Going back to the subject of maintenance wholly by section gangs, there is no doubt in the mind of the writer but this is the best and most economical method of handling repair work. The trouble is we are not allowed sufficient help on the section at the proper time. If there were four men on each section all the time, the work could be taken care of in good shape and the company would not be compelled to spend large sums of money each year in employing extra gangs, whose work at the best is far from being satisfactory.

Plans have been prepared for a new steel bridge at Law street, at Appleton, Wis., to be built jointly by the city of Appleton, C. & N. W., C. M. & St. P. and Wisconsin Electric Companies at a cost of about $50,000.

Young & Hichborn, of Los Angeles, Cal., have been awarded the contract for the new freight warehouse at the foot of Broadway, San Diego, Cal., for the Atchison, Topeka & Santa Fe.

The William Simpson Construction Co., of San Diego, Cal., has been awerded the contract for the construction of the Atchison, Topeka & Santa Fe depot at San Diego.

The Baltimore & Ohio will build a viaduct at Cross street, Baltimore, Md., costing $125,000.

The Canadian Pacific has awarded contracts for shops at Empress, Sask., and at Shaunavon, Alta., costing about $100,000.

The Chesapeake & Northern is receiving bids on its proposed $2,000,000 bridge to be erected across the Ohio river. It is said that bids will be opened in New York City on June 11.

The Chicago, Burlington & Quincy will build a station at LaGrange, Mo.

The Chicago, Milwaukee & St. Paul it is said has ordered 478 tons of bridge steel from the Wisconsin Bridge & Iron Co. This road has let the contract for bridges on the Great Falls-Choteau line to D. J. Burke.

The Erie has been ordered to submit amended plans for the elimination of grade crossings, at Youngstown, Ohio, costing about $2,000,000.

The Pennsylvania is reported as having prepared plans for a warehouse at Erie, Pa., to cost $60,000.

Personals

Operating

F. M. WOODALL, formerly trainmaster, has been promoted to superintendent of the *Atlanta, Birmingham & Atlantic Ry.* at Manchester, Ga., succeeding E. F. Kirkland.

J. M. BARRETT has been appointed superintendent of the *Canadian Pacific Ry.* at Montreal, Que. He succeeds R. W. MCCORMICK, appointed superintendent at Farnham, Que., succeeding W. B. Way.

C. R. FUNK, formerly chief engineer, has been promoted to superintendent and chief engineer of the *Chestnut Ridge Ry.*, office at Palmerston, Pa., succeeding to the duties of C. H. VanderVeer, superintendent. He entered railroad work July, 1898, as clerk in the auditor's office of the O. K. C. & R. R. at Kansas City, Mo. From August, 1900, to September, 1902, he was clerk and timekeeper in superintendent's office of Iowa & St. Louis Ry. at Connelsville, Mo. From September, 1902, to June, 1904, he was paymaster and timekeeper for the Manufacturing Coal & Coke Co. at Connelsville, Mo., and returned to railway work in June, 1904, as rodman on a railway location party in Kansas. From February, 1905, to February, 1908, he was levelman for the Central R. R. of New Jersey, and in July, 1912, was appointed assistant engineer of the Chestnut Ridge Ry. From July, 1912, to May, 1914, he was chief engineer, and was promoted also to superintendent, May 1, 1914.

H. C. OVIATT, Superintendent
New York, New Haven & Hartford R. R.

A. E. CAMPBELL, formerly trainmaster, has been promoted to superintendent of the *Chicago, Milwaukee & St. Paul Ry.* at Malden, Wash. He succeeds MOTT SAWYER, appointed superintendent at Spokane, Wash.

G. W. ROURKE, formerly superintendent, has been promoted to assistant general manager of the *Chicago, Rock Island & Pacific Ry.* at Topeka, Kan., succeeding J. B. Smalley, deceased. A. B. RAMSDELL, formerly trainmaster, has been promoted to superintendent at Rock Island, Ill., succeeding Mr. Rourke.

J. T. LOREE, formerly assistant trainmaster, has been promoted to superintendent of the *Delaware & Hudson Co.* at Oneonta, N. Y., succeeding J. H. Rosenstock.

D. F. KIRKLAND has been appointed general manager of the *Georgia & Florida Ry.* at Augusta, Fla., succeeding B. W. Duer, resigned.

J. P. HOUSTON, formerly assistant superintendent, has been promoted to superintendent of the *Minneapolis & St. Louis R. R.* at Oskaloosa, Ia., succeeding R. S. Marshall.

R. D. FITZMAURICE, formerly superintendent of the *New York,*

New Haven & Hartford R. R. at Waterbury, Conn., has been appointed superintendent at Providence, R. I. W. H. FOSTER, formerly superintendent at New Haven, Conn., has been appointed superintendent at Harlem River, N. Y. J. D. GALLARY, formerly superintendent at Providence, R. I., has been appointed superintendent at New Haven, Conn. A. W. HONYWILL, formerly superintendent at Hartford, Conn., has been appointed superintendent at Boston, Mass. H. C. OVIATT, formerly trainmaster, has been promoted to superintendent at Waterbury, Conn., succeeding Mr. Fitzmaurice.

As announced in our June issue, C. H. MOTSETT has been appointed superintendent of the *Panama R. R.*, office at Colon, R. P. He was born at Peoria, Ill., December 4, 1873, and attended public schools at that point eight years. He entered railway service March, 1891, as clerk in the Great Eastern Fast Freight Line office, and then entered service of the C., R. I. & P. Ry. as yard clerk, serving as yard clerk and switchman alternately at Peoria, Ill., up to September 1, 1902. He was then transferred to Rock Island, Ill., as assistant night yardmaster, and promoted April 1, 1903, to assistant general yardmaster of the Tri-City Terminals (Moline, Rock Island, Ill., and Davenport, Ia.). On October 1, 1903, he was transferred to Council Bluffs, Ia., as general yardmaster, and October 3, 1904, transferred to Des Moines, Ia., as general yardmaster, in charge of the Des Moines and Valley Junction terminals. November 1, 1905, he resigned to accept a position as trainmaster with the Minneapolis & St. Louis Ry., with headquarters at Des Moines, Ia., and remained with that company until February 16, 1908, when he resigned to accept a position with the N. Y., N. H. & H. R. R. as freight trainmaster of the New York division. On September 15, 1909, the New York division was abolished and he was appointed trainmaster of freight terminals at Harlem River, with jurisdiction over Harlem River branch, New York freight stations, East River piers and the lighterage department. On September 15, 1913, the old New York division was re-established and he was appointed division superintendent. He resigned May 20, 1914, to accept the position as superintendent, Panama R. R.

J. W. EVERMAN has been appointed general manager of the *St. Louis South Western Ry.*, office at Tyler, Tex.

The offices of the following officers of the *Seaboard Air Line Ry.* have been moved from Portsmouth, Va., to Royster Bldg., Norfolk, Va.: C. S. LAKE, general superintendent; C. E. HIX, superintendent of transportation; W. F. WILLIAMS, superintendent of telegraph. P. G. WALTON has been appointed superintendent of the North Carolina division at Hamlet, N. C., succeeding W. A. Gore, resigned.

Engineering

W. J. OVERTON has been appointed acting division engineer in the construction department of the *Atlantic Coast Line R. R.* at Jesup, Ga., succeeding M. S. McDanel, transferred. J. P. WALKER, division engineer, has been transferred from Richmond to Petersburg, Va.

C. H. N. CONNELL, engineer maintenance of way of the *Canadian Northern Quebec Ry.*, has moved his office from Quebec to Montreal, Que.

G. A. DELACHEROIS has been appointed resident engineer of the *Canadian Pacific Ry.*, Saskatchewan division, at Saskatoon, Sask. He succeeds K. A. DUNPHY, appointed resident engineer at Vancouver, B. C. T. D. RUGGLES, formerly assistant engineer on the Fort William terminals, has been appointed resident engineer at Kenora, Ont., Manitoba division, succeeding J. M. Campbell, promoted.

H. E. ASTLEY, formerly supervisor of track on the *N. Y., N. H. & H. R. R.*, has been appointed division engineer of the *Central New England Ry.* at Hartford, Conn., succeeding W. D. Warren.

W. H. FINLEY, assistant chief engineer of the *Chicago & North Western*, has been appointed chief engineer, with headquarters at Chicago, succeeding E. C. Carter, resigned. Mr. Finley was born in New Castle county, Delaware, and was educated in the public schools at Wilmington, Del., and by private instruction in engineering. He entered the service of the Edgemoor Iron Co. at Wilmington in 1881, leaving in 1887 to begin railway work in the bridge and building department of the Chicago, Milwaukee & St. Paul Ry. He left the employ of that road in 1892 to go to the Chicago & North Western Ry. as engineer of bridges. Since then he has been successively principal assistant engineer and assistant chief engineer, being promoted to chief engineer June 1. Mr. Finley is a member of the American Society of Civil Engineers, and is past president of the Western Society of Engineers and the Chicago Engineers' Club.

WM. H. FINLEY, Chief Engineer
Chicago & North Western Ry.

H. E. ASTLEY, Division Engineer
Central New England Ry.

B. B. SHAW, Assistant Engineer
Chicago, Rock Island & Pacific Ry.

GEO. W. HAND has been appointed valuation engineer of the *Chicago & North Western Ry.*, and also of the *Chicago, St. Paul, Minneapolis & Omaha Ry.*, office at Chicago, Ill. He was born at Huntertown, Ind., and educated in the schools at Fort Wayne, Ind., and at Purdue University, in civil engineering. He was first employed by the C. & N. W. Ry. in 1903, and has been with this company continuously since that date, engaged in location, construction and maintenance work. He has been in general charge of valuation since 1907.

H. B. SHOEMAKER has been appointed engineer maintenance of way of the *Chicago, Indiana & Southern R. R.*, office at Gibson,

Lake Co., Ind. He succeeded M. C. Cleveland, who has been appointed engineer of valuation of the Lehigh Valley R. R., as previously announced.

W. P. CORRIN has been appointed assistant engineer of the *Chicago, Rock Island & Pacific Ry.* at Little Rock, Ark. G. H. PASH has been appointed assistant engineer at El Reno, Okla. L. P. ROSSITER, formerly assistant engineer at Des Moines, has been appointed assistant engineer at Manley, Ia., succeeding Noah Johnson. B. B. SHAW has been appointed assistant engineer in the maintenance of way department, Indian Territory division, at Haileyville, Okla., succeeding A. H. Sturdevent, promoted. Mr. Shaw was previously, since August 1, 1912, assistant to the engineer in charge of construction of the St. Paul & Kansas City Short Line Ry.

R. BIRBECK has been appointed chief engineer of the *Cuba R. R.* office at Camaguey, Cuba. W. C. MCCANDLESS has been appointed assistant engineer at Placetas del Sur, Cuba.

T. GRONER has been appointed chief engineer of the *Detroit, Toledo & Ironton R. R.*, office at Springfield, O. He was born in Bodo, Norway, May 29, 1883, and graduated from Trondhjems Tekniske Loereanstalt in 1903, with the degree of civil engineer. He came to America in 1904, and was employed as a draftsman by the N. Y., O. & W. Ry. in May, 1904, and promoted to bridge inspector in February, 1905. He was appointed draftsman and office assistant to the chief engineer of the Ashland & Ironton Bridge Co., incorporated, to construct a cantilever bridge over the Ohio River at Ironton, O. In July, 1906, he entered the service of the O. S. L. R. R. as draftsman and late in 1907 was appointed assistant engineer of station surveys. He entered Syracuse University in the spring of 1908, and received the degree of electrical engineer in 1910, and was then appointed assistant engineer on physical revaluation of the O. S. L. R. R. He was appointed division engineer on construction in the winter of 1911, and promoted to engineer in charge of construction in the fall of 1912, holding the latter position till his appointment as chief engineer of the D. T. & I. R. R. Mr. Groner is an associate member of the American Society of Civil Engineers, a member of the Utah Society of Engineers and a member of the Detroit Engineering Society.

A. G. DORLAND, assistant engineer of the *Elgin, Joliet & Eastern R. R.*, has been transferred from Gary, Ind., to Joliet, Ill.

ALEX. STEWART, assistant chief engineer of the *Great Northern Ry.* at Seattle, Wash., died June 6, 1914, of Bright's disease, aged 60. He had been in failing health for eighteen months. Mr. Stewart had been identified with the Great Northern engineering department for twenty years as locating and construction engineer, division engineer and assistant chief engineer. Extensive improvements in the West were carried on under his direction, including the tunnel under the city of Seattle, concrete snowsheds in the Cascades, terminal improvements at Spokane, Everett, Seattle, Vancouver, B. C., and other points. Prior to his service with the Great Northern, Mr. Stewart was chief engineer of the Duluth & Winnipeg, located the Portage La Prairie line for the provincial government of Manitoba, and also located the Prince Edward Island Railway in the 80's for the Dominion Government. He was a member of the Canadian Society of Civil Engineers.

As announced in our June issue, OSCAR S. BOWEN has been appointed principal assistant engineer of the *Great Northern Ry.* at Seattle, Wash. He has been engaged in engineering work for the past 26 years in the Northwest, being engaged the most of this time on railway construction in Montana, Idaho, Washington and British Columbia. He was resident engineer for the Great Northern Ry. at Spokane from 1901 to 1913, and resident engineer at Seattle from 1913 until May 15, 1914, the date of his appointment as principal assistant engineer.

A. L. ADAMS has been appointed assistant engineer of the *Louisville & Nashville R. R.* at Nashville, Tenn., succeeding A. W. May.

H. S. JONES, formerly division engineer, has been promoted to special engineer of the *Mobile & Ohio R. R.*, office at Mobile, Ala.

W. T. SPENCER, division engineer maintenance of way of the *New York, New Haven & Hartford R. R.*, has been transferred from Waterbury, Conn., to Providence, R. I. PAUL STERLING, division engineer maintenance of way, has been transferred from Hartford to Waterbury, Conn. W. D. WARREN has been appointed division engineer maintenance of way at Hartford, Conn., succeeding Mr. Sterling. J. S. BROWNE, formerly division engineer maintenance of way, has been promoted to assistant engineer, office at New Haven, Conn.

F. X. SOETE, formerly roadmaster, has been promoted to valuation engineer of the *New York, Ontario & Western Ry.*, office at Middletown, N. Y.

As announced in our June issue, E. V. BRADEN has been appointed engineer of the *Pittsburgh, Chartiers & Youghiogheny Ry.*, office at Pittsburgh, Pa. He entered the service of the Pennsylvania Lines West when a boy, and after several years left to attend Washington and Jefferson College, from which he graduated in 1903. He entered the service of the P. C. & Y. Ry. in the maintenance department, was appointed chief clerk to superintendent, and in 1906 was appointed assistant to the consulting engineer, Thomas H. Johnson. He held the latter position until the death of Mr. Johnson, succeeding to the latter's duties but with the title of engineer.

As announced in our June issue, H. E. TYRRELL has been appointed supervising engineer of the *Southern Ry.*, office at Washington, D. C. He has been connected with this railway for eight years as assistant engineer and office engineer. Previous to that time he was employed since 1901 on the Norfolk & Western Ry., on the Pennsylvania R. R., with the American Bridge Co. and with the Eastern Steel Co.

W. T. DOBYNS, engineer maintenance of way of the *Southern Ry.*, has moved his office from Greensboro to Richmond, Va. O. B. LACKEY, formerly assistant roadmaster, has been appointed resident engineer at Memphis, Tenn., succeeding B. R. Hundley. P. NELSON and O. PARATI, assistant engineers, have been transferred from Greensboro to Richmond, Va. P. L. THOMPSON has been appointed assistant engineer at Richmond, Va. H. H. BOYD has been appointed junior engineer at St. Louis, Mo. O. H. HERRING has been appointed junior engineer at Richmond, Va.

P. CAIN, division engineer of the *Western Maryland Ry.*, has been transferred from Elkins, W. Va., to Cumberland, Md.

Bridges and Buildings

D. H. MAPES has been appointed superintendent of building construction of the *Canadian Pacific Ry.*, office at Montreal, Que. He was engaged in the contracting and building business in New York for 22 years, and has been with the C. P. Ry. for two years.

The office of W. H. MULCAHY, foreman of bridges, buildings and water supply on the *Chicago & North Western Ry.*, has been moved from Friendship to Adams, Wis.

D. F. MCLAUGHLIN has been appointed architect of the *Illinois Central R. R.*, office at Chicago, Ill., succeeding J. A. Taggart.

A. VICKERS has been appointed architect of the *New York Central & Hudson River R. R.*, office at New York City, succeeding D. R. Collin.

Signal

L. BROWN has been appointed senior assistant signal engineer of the *Atchison, Topeka & Santa Fe Ry.*, office at Topeka, Kan. G. K. THOMAS has been appointed junior assistant signal engineer, office also at Topeka. B. T. ANDERSON, assistant signal engineer, has resigned. W. H. RIFE, formerly division signal foreman, has been promoted to signal supervisor at La Junta, Colo. A. BROWN, division signal foreman, has been transferred from Emporia, Kan., to Marceline, Mo., succeeding Mr. Rife. E. H. CLARK, division signal foreman, has been transferred from Arkansas City, Ark., to Emporia, Kan., succeeding A. Brown. B. F. SMITH has been appointed division signal foreman at Arkansas City, Ark., succeeding Mr. Clark.

G. FLEISSNER, formerly signal repairman, has been promoted to signal construction foreman of the *Chicago, Milwaukee & St. Paul Ry.* at Milwaukee, Wis., succeeding T. J. Wilkinson.

J. H. MOLLOY has been appointed signal supervisor of the *Chicago, Rock Island & Pacific Ry.* at Fort Worth, Tex.

W. L. TALEVICH has been appointed division signal foreman of the *Gulf, Colorado & Santa Fe Ry.* at Galveston, Tex., succeeding G. T. Leonard.

R. C. EXLEY has been appointed inspector of signals of the *Lake Shore & Michigan Southern Ry.*, office at Cleveland, O., succeeding W. C. Sibila.

G. H. CALEY has been appointed electrical and signal supervisor of the *New York, Ontario & Western Ry.*, office at Middletown, N. Y., succeeding W. H. Harland. Mr. Caley has been connected with the N. Y. O. & W. Ry. since entering railway work, having previously held the following positions: electrical draftsman, four years; electrical foreman, two years; signal maintenance foreman, two years; general electrical inspector, two years. He held the latter position at the time of his appointment as electrical and signal supervisor.

R. HEARD, supervisor of signals of the *Union Pacific R. R.*, has been transferred from Cheyenne to Green River, Wyo.

As announced in our June issue, O. A. CHARLTON has been appointed supervisor of signal construction, *Southern Pacific Co.*, headquarters 1110 Flood Bldg., San Francisco, Calif. He entered the service of this company October 1, 1902, in the engineering department, serving on railroad construction work, and on May

O. A. CHARLTON, Supervisor Signal Construction : Southern Pacific Co.

1, 1904, was transferred from the engineering to the signal department on the San Joaquin division, working as maintainer's helper, and in September was made maintainer of automatic signals. On January 1, 1905, he went to the Los Angeles Division as maintainer, and in June, 1906, went on automatic signal construction as signal wireman. On December 1 he returned to Los Angeles and was given the care and charging of storage batteries for the Los Angeles division, working in the signal shop at that place until August 1, 1907, when he was made foreman of automatic signal construction, serving in that capacity until August, 1910, when he was appointed assistant supervisor of signals on the San Joaquin division. April 1, 1912, he was appointed general foreman of signal construction, which position he held till his present appointment.

Maintenance of Way

G. M. ELLIOTT, assistant roadmaster of the *Canadian Northern Ontario Ry.*, has been transferred from Beaverton to Sudbury, Ont. E. HAYSTEAD, assistant roadmaster, has been transferred from Sydenham to Parry Sound, Ont. O. OGDEN, assistant roadmaster, has been transferred from Sudbury to Sydenham, Ont.

J. SHEAHAN has been appointed general roadmaster of the *Canadian Pacific Ry.*, British Columbia division, at Revelstoke, B. C., succeeding P. Wade. W. CODE has been appointed general track supervisor at Montreal, Que. J. M. CAMPBELL, formerly resident engineer, has been promoted to roadmaster at Winnipeg, Man., Manitoba division, succeeding A. Lyons. P. CARLSON has been appointed roadmaster of the Alberta division at Calgary, Alta., succeeding R. H. Ford. J. J. CLIFFORD has been appointed roadmaster of the British Columbia division at Salmon Arm, B. C. M. LONG, roadmaster on the Ontario division, has been transferred from Kingston to West Toronto, O., succeeding G. Spicer, appointed roadmaster at Kingston, Ont. JOHN MACKIE has been appointed roadmaster of the Saskatchewan division at Weyburn, Sask., succeeding T. Roulson. J. TELFORD, formerly extra gang foreman, has been promoted to roadmaster of the Ontario division at Kingston, O. P. WADE has been appointed roadmaster of the British Columbia division at Nelson, B. C. E. WALKER, roadmaster on the British Columbia division, has been transferred from Field to Golden, B. C. E. WALLACE, roadmaster on the Saskatchewan division, has been transferred from Moose Jaw to Saskatoon, Sask. GEORGE WHARTON has been appointed roadmaster of the British Columbia division at Grand Forks, B. C., succeeding E. Hall. F. A. YOUNG has been appointed roadmaster of the Saskatchewan division at Wilkie, Sask., succeeding E. Warring.

R. HEFFRON, supervisor of the *Chicago & Alton Ry.*, has been transferred from Jacksonville to Bloomington, Ill.

E. CUSH has been appointed roadmaster of the *Chicago, Milwaukee & St. Paul Ry.* at Walworth, Wis. He succeeds A. H. HOBERT, appointed roadmaster at Chillicothe, Mo. Mr. Hobert succeeds H. JASPER, appointed roadmaster at North MacGregor, Ia., in place of J. H. Tayek.

JOHN HAYES has been appointed roadmaster of the *Chicago, Rock Island & Pacific Ry.* at Estherville, Ia. J. S. POLLARD has been appointed roadmaster at Goodland, Kan., succeeding H. O. Sinsabaugh.

H. CORDOZA has been appointed roadmaster of the *Cuba R. R.* at Jobabo, Cuba. F. THOMPSON has been appointed roadmaster at Placetas del Sur, Cuba. G. M. TUTTLE has been appointed roadmaster at San Luis, Cuba.

T. H. BARROW has been appointed roadmaster of the *Cuba Central R. R.* at Sagua, Cuba.

W. E. FLAHERTY, previously extra gang foreman, has been promoted to supervisor of track of a newly created sub-division of the *Grand Trunk Ry.* at Island Pond, Vt.

S. ALLEN, previously rail inspector, has been appointed assistant roadmaster of the *Great Northern Ry.* at Grand Forks, B. C., succeeding S. Roper, transferred. T. ARGENBRIGHT has been appointed assistant roadmaster at Havre, Mont., succeeding Edward Johnson. H. CONNELL has been appointed assistant roadmaster at Leavenworth, Wash. THOS. DEIGHTON, assistant roadmaster, has been transferred from Bellingham to Everett, Wash., succeeding C. HOLM, assistant roadmaster, transferred to Bellingham, Wash. OLE HERMAN, formerly section foreman, has been promoted to assistant roadmaster at Louisburg, Minn., succeeding Fred Feldton. R. HUGHES has been appointed assistant roadmaster at Lakota, N. D., succeeding J. Severson. S. C. ROPER, formerly assistant roadmaster at Grand Forks, B. C., has been appointed assistant roadmaster at Chewelah, Wash.

J. D. HITCHCOCK, roadmaster of the *Missouri Pacific Ry.*, has been transferred to Monroe, La., succeeding W. M. Bowen. G. W. TULL, formerly acting roadmaster, has been promoted to roadmaster at Coffeyville, Kan.

H. M. CURTIS, track supervisor of the *New York, New Haven & Hartford R. R.*, has been transferred from South Braintree to Boston, Mass., succeeding H. A. Pellett, transferred to Readville, Mass. J. S. RUFF has been appointed track supervisor at South Braintree, Mass., succeeding H. E. Astley.

F. J. MEYER, formerly supervisor, has been promoted to acting roadmaster of main line sub-division No. 2, of the *New York, Ontario & Western Ry.*, office at Walton, N. Y., succeeding F. X. Soete, promoted to valuation engineer. J. G. EWING, formerly transitman, has been promoted to supervisor of the Kingston, Port Jervis, and Monticello branches, office at Ellenville, N. Y., succeeding Mr. Meyer.

N. D. VERNON, Supervisor
Pennsylvania R. R.

J. D. McNAMARA has been appointed roadmaster of the *Norfolk & Western Ry.* at Portsmouth, Va.

HANS OLSON has been appointed assistant roadmaster of the *Northern Pacific Ry.* at Staples, Minn.

J. A. BURCHENAL, formerly supervisor of the *Pennsylvania R. R.*, at Mifflin, O., has been appointed supervisor at Tacony, Pa. J. S. ELLIOTT, formerly supervisor of the P. B. & W. R. R., has been appointed supervisor at Williamsport, Pa., succeeding J. G. HARTLEY, appointed supervisor at Philadelphia, Pa. H. E. WATERS has been appointed supervisor at Mifflin, Pa., succeeding Mr. Burchenal.

W. F. RENCH has been appointed supervisor of the *Philadelphia, Baltimore & Washington R. R.* at Perryville, Ind., succeeding J. S. Elliott. W. G. SHANER has been appointed supervisor at Bowie, Md., succeeding H. E. Waters, transferred. N. D. VERNON has been appointed supervisor at Harrington, Pa.

WM. PROFFIT has been appointed supervisor of the *Wabash R. R.* at Brunswick, Mo., succeeding G. C. Lovell.

T. M. WOODWARD, formerly with the P. B. & W. R. R., has been appointed supervisor of the *West Jersey & Sea Shore R. R.* at Millville, N. J., succeeding H. H. Garrigues.

New and Improved Appliances

A PRACTICAL, CONTINUOUS CROSSING.

The rapid wear of frog points and resulting low life of crossing frogs has recently attracted increasing attention on account of the increasing weight, speed, and number of trains on trunk lines. Manganese steel has been adopted extensively in design, both solid and built-in types of frogs now being widely used.

Manganese, if of good quality, undoubtedly increases the life of a frog greatly. And the development of manganese designs has made possible the use of frogs of lesser angle, thus increasing the latitude of the engineer in designing layouts ,and making it possible to put in higher speed turnouts and crossovers.

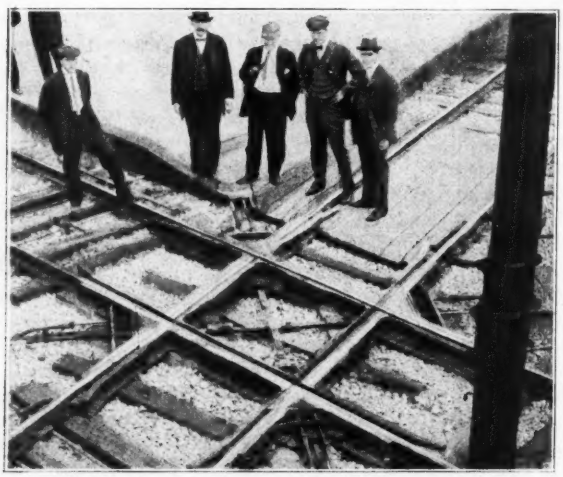
The use of manganese in an ordinary frog crossing marks a step in advance. But such designs are still in a measure subject to some of the disadvantages of the bessemer frog—the wheels must jump across the open flangeway of the opposing track, and this introduces a severe jar to wheels and journals, and in fact to the entire car. The noise and jar of passing over a right-angle crossing at high speed is sufficient to awaken sound sleepers in the best designed Pullman.

The crossing suffers fully as much as the cars do. Every blow must be absorbed by the rails, ties, and ballast. The maintenance is therefore very high, crossings requiring constant attention from the section foreman to keep the bolts tight, and to keep the crossing in surface and alignment.

Consideration of the above features indicates why many have attempted to design continuous crossings which would eliminate the break in the track, with its attendant disadvantages. A great many designs, however, have been impractical in that they overlooked the necessity for simplicity of operation in connection with practical design and rugged construction.

The practicability of the design, illustrated herewith, is in pleasing contrast to many we have seen advocated. The simplicity of operation is indicated by the fact that there are only six moving parts in the structure, and of these four are the corners which carry the wheels. In other words, the operation is performed by two movable parts, the two bars running diagonally from corner to corner as shown in the illustrations.

The plan herewith further illustrates the way these operating bars work without springs, cogs, or levers of any kind. The frog corners are moved from normal to opposing position by moving the



Continuous Crossing at Carruthersville, O.

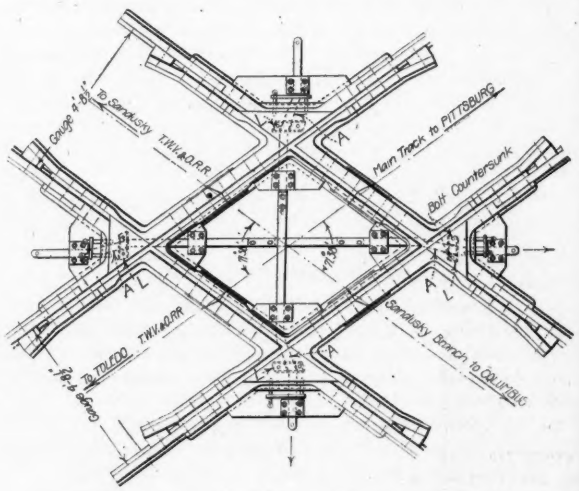


Diagram of Continuous Crossing.

operating rods in the direction (longitudinal) indicated by the arrows. The angle "A," during this movement, forces the lug "L" (which is bolted to the corner plates) over, thus pushing the frog corners to their opposite positions. The bars are held against lateral motions by the guides on the tops of the base plates, or straps bolted in corners. The frog corner plates are held in position by the heavy operating cross bars working through the lugs—these bars and lugs being made of 3x⅞ in. steel bars.

The entire crossing is of manganese, so that the great wearing power of this metal is procured, in addition to the much greater wear obtained through the elimination of the flangeway opening. The frog rails are also provided with extension easers to which the track rails are bolted (shown in illustrations). There are no frog bolts in the crossing. The bolts shown are ordinary track bolts used at the joints with fish plates, or bolts for the interlocking.

The illustration herewith is of an installation recently made on an interlocked crossing of the Pennsylvania R. R. The two center rods running from adjacent corners are those used to operate the crossing, the other two bars at each corner providing bolt locks. Operating rods are connected to and moved by one lever in the tower, and two levers operate the bolt locks. The latter are merely plungers which work into holes in the frog corners, one hole for each position of the frog corner. These bolt locks are adjusted in accordance with standard practice, and the tower interlocking will prevent the derail being lined up or signal cleared until all of the four bolt locks have registered in the proper holes in the frog corners.

The installing of one of these continuous crossings is the same as the replacing of an ordinary frog crossing. This is a valuable feature, as compared with designs which require a special foundation. Ordinary track ties or the heavy timbers used under an old frog can be left in, the old crossing slid out, and the continuous crossing slid in. In putting in the frog shown above, the track was held only 32 minutes by the trackmen. The connection with interlocking levers, or hand levers, is simple and requires nothing of a special nature.

The above design has been in the process of development for several years and is now perfected and being placed on the market by the Eymon Continuous Crossing Co., 119 West Center St., Marion, O.

R. N. R. FROG CONTEST.

In the April issue of *Railway Engineering* the Indianapolis Switch & Frog Co. announced a $50.00 prize contest. The conditions of this contest were "A cash prize of fifty dollars will be paid to the engineer, roadmaster, supervisor, or track foreman submitting the five best points of merit of the R. N. R. type of frog."

Twelve contributions were received in this contest, all of which were sent in care of *Railway Engineering*. The method of awarding the prize was as follows: The signatures and titles of all contributors were cut off in this office, after the body of the letter and the signature had been given the same number. For instance, the body of the first letter received and the man's signature were each numbered "1," the second letter "2," etc. The letters were forwarded to the advertising manager of I. S. & F. Co., and the signatures retained in the office of *Railway Engineering*.

The prize was awarded to No. 7, which, on referring to the file, was found to be the letter contributed by Herman Lorenz, an assistant engineer on the Big Four Ry. at Cincinnati, O., to whom a check for $50.00 was forwarded.

Illustration Showing Details. Notice Fit of Manganese Cast...gs.

INTERLOCK RAIL ANCHOR.

The rail anchor shown herewith has been styled the "Interlock" because it does not depend on a movement of the rail to bring the anchor to its permanent grip or "bite" on the rail.

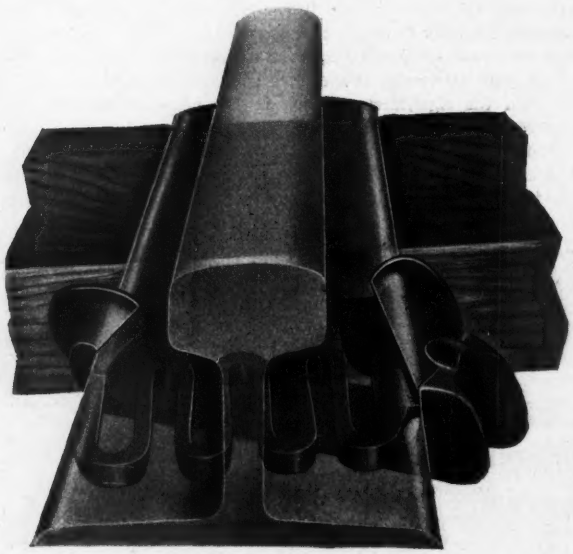
The anchor is in two parts, which are shown very clearly above. One of these parts consists of a malleable iron ribbed bar which extends under the rail, diagonally, at an angle of about 30 degrees. This bar is designed to take the stress set up when resisting rail movement, and the major portion of the stress comes across the back of the bar, where the rib is about twice as large as the rib on the front of the bar.

The spring portion of the bar is also of malleable iron. This part of the anchor is made light, with the exception of the wedge which engages the socket in the bar. This part is made heavy to resist the stress due to the wedge action. Especial attention should be called to the wedging angle, which is very sharp, and precludes absolutely the danger of a laborer wedging the two parts of the anchor tighter and tighter until something breaks.

The locking is not dependent on driving the two parts of the anchor together. The spring is placed under the rail, and the bar is

placed in position so that the wedge socket engages the wedge on the spring, the opposite end of the bar being a quarter or half inch ahead of its proper relative position. The anchor is then locked by forcing the end of the spring back of the ribbed bar; this is accomplished by holding a spike against the shoulder on the spring (indicated by arrow on illustration) and tapping the spike with a hammer.

The resistance to movement of the rail merely tends to force the socket and wedge more tightly together, but sets up no stress in the spring. The function of the latter is to hold the parts



Interlock Rail Anchor.

in correct relative position, which it does as soon as the point springs out and rests against back of rib.

To remove the anchor, the end of the spring is tapped with a hammer, laterally of the track, which springs the end in a quarter inch, beyond the rail clamp of the ribbed bar; a light blow on the latter is sufficient to disengage the anchor.

The self-locking anchor described herein is being marketed by Joe M. Vail, Marion, O.

Industrial Notes

The Seattle office of the AMERICAN HOIST & DERRICK Co. has been moved from 613 Western avenue to 1512 L. C. Smith building. The L. C. Smith building is one of the highest and best equipped office buildings in the country, and its central location will be more convenient for out of town customers.

The GUN-CRETE COMPANY has opened its new offices in the McCormick Bldg., Chicago. This firm specializes in Cement-Gun work for engineering, industrial and mining and railway structures. It has at its disposal a large amount of the most modern Cement-Gun equipment, and a very efficient working organization. The Gun-crete process is of especial value for railway work. It is now extensively used for the encasing of steel bridges, etc., as rust and fire protection for the lining of tanks, reservoirs and for the fireproofing of wooden trestles. The process has also been used for the sealing of fissures in rock cuts and by encasing with Gun-crete temporary frame structures can easily be transformed into permanent, sanitary buildings. Mr. Carl Weber, the president of the Gun-crete Company, is one of the well known concrete engineers of America. He is the inventor of the reinforced concrete chimney, of which thousands have been built in this and foreign countries, and has designed and built a large number of other important engineering structures. He has been connected with Cement-Gun operations for some time and is considered to be one of the leading experts in this line of work.

THE HATFIELD RAIL JOINT MANUFACTURING Co., of Macon, Ga., has entered into arrangements with T. B. Bowman, formerly Ass't to the President of The Q. & C. Co., New York, and now of The Efficiency Co., to assume general charge of the sales of the Hatfield Rail Joint, with offices at No. 2 Rector Street, New York, and 700 Railway Exchange, Chicago.

Allan Wallace has been appointed traffic manager of the H. W. JOHNS-MANVILLE Co., New York, with office at the company's headquarters in New York City, effective on June 8. Mr. Wallace was formerly connected with the Grand Trunk Railway, and has served in various capacities in the traffic department of that company.

THE NATIONAL TUBE Co. has moved its Chicago office from 1397 McCormick Building to room 1114, 288 South La Salle street.

Fred A. Poor, Chicago representative of THE RAIL JOINT Co., resigned on June 1 to become President of the P. & M. Co., whose general offices are in the Railway Exchange Building, Chicago, Ill.

J. A. Bodkin has resigned his position as engineer for the Q. & C. Co. to become associated with his brother in the TRACK SPECIALTIES Co., 29 Broadway, New York City.

George C. Isbester, for the past three years attached to the New York office of the RAIL JOINT Co., has been given charge of its Chicago office, at 215 Railway Exchange building.

C. H. McCormack has been promoted to vice-president of the STANDARD HEAT & VENTILATOR Co., with office at 1949 People's Gas building, Chicago.

THE TITANIUM ALLOY MANUFACTURING Co. has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. Wm. M. Corse, formerly works manager of the Lumen Bearing Co., Buffalo, N. Y., and lately general manager of the Empire Smelting Co., Depew, N. Y., will be associated with the company as manager of this department.

J. H. Johnson has resigned as secretary and treasurer of the UNION SWITCH & SIGNAL Co., and T. W. Siemon has been elected secretary and treasurer to succeed him.

L. R. Pomeroy, a railway and electrical engineer of prominence, has been appointed manager of the New York sales office, 16-24 W. 61st St., of THE U. S. LIGHT & HEATING Co., the general offices of which are now at Niagara Falls, N. Y. Mr. Pomeroy has long been engaged in work in the railway and electrical fields, and enjoys the reputation of being an authority along several lines in each industry. He was born at Port Byron, N. Y., in 1857, and attended high school at Milwaukee, Wis., and the Irving Institute at Tarrytown, N. Y. From 1874 to 1880 he was engaged in commercial business, bookkeeping, special auditing, drafting and designing of cars and locomotives. From 1880 to 1886 he was secretary and treasurer of the Suburban Rapid Transit Company of New York. For four years following this he was a special representative of the Carnegie Steel Company, introducing basic boiler steel for locomotives and special forgings for railways. For nine years he was engaged in the same work with the Cambria Steel Company and the Latrobe Steel Company, jointly; this assignment involved metallurgical engineering and experimental research to adapt special steels for railway axles, crank pins and piston rods. From 1899 to 1902 he was assistant general manager of the Schenectady Locomotive Works. For six years following this he was a special representative in the railway field for the General Electric Company, this work covering the electrification of steam roads, railway shops and the general application of electricity for all railway purposes. Following this he was for two years assistant to the president of the Safety Car Heating & Lighting Company, during which period he devoted a portion of his time to consulting work in the special field or railway shops and machine tool operation. From the Safety Company he went with J. G. White & Co., New York, as chief engineer of the railway and industrial division. Before becoming associated with the U. S. Light & Heating Co. he had an office at 50 Church St., New York, and served a large clientele as consulting engineer.